AMERICAN DOUGLAS FIR AND ITS USES

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UNITED STATES DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF FOREIGN AND DOMESTIC COMMERCE
WILLIAM L. COOPER, Director

Trade Promotion Series—No. 87

AMERICAN DOUGLAS FIR AND ITS USES

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FOREWORD

With the growing appreciation in foreign countries of American woods for special purposes, there is a need of authoritative information in regard to the properties and qualities of our principal species. Such information as is available is scattered through many publications, and practically no such data have been specially prepared for foreign consumers. To supply that lack, this bulletin on Douglas fir and its uses has been compiled by the Lumber Division and the National Committee on Wood Utilization of the Department of Commerce, with the assistance of the field staff of the Bureau of Foreign and Domestic Commerce.

A careful study of this publication will inform the prospective foreign user of Douglas fir of its most efficient uses and how to secure from it the greatest satisfaction. Foreign consumers should be particularly interested in this wood because of the large supply of virgin timber available and the rapid growth of the trees, which will insure a supply in the future sufficient to cover both foreign and domestic requirements.

Acknowledgement is made of the services performed by Mr. S. Borglind, who furnished the pencil and pen-and-ink drawings used in this publication.

William L. Cooper, *Director*,
Bureau of Foreign and Domestic Commerce.

October, 1929.

AMERICAN DOUGLAS FIR AND ITS USES

On all the seven seas are ships that use and carry Douglas fir. Use it for their own masts and spars and decking. Carry it as cargo. Carry it to buyers in every land, in every walk in life; for nearly every need.

There is romance in the story of Douglas fir—the romance of adventuring and of high achievement; for interwoven with the story of Douglas fir, first known abroad as Oregon pine and still largely so marketed, is the stirring narrative of the Pacific Northwest. Nowhere else is this tree logged commercially, nowhere else is there a softwood stand of such immensity. The whole world must look to this one region for this wood.

One can not say with certainty just when the existence of these giant forests first became generally known. Within 30 years after the discovery of the Pacific Ocean the Spaniards had explored the western rim of the American Continent to the forty-second parallel; Bartolome Ferrelo, in his voyage of 1543, may have reached what afterwards was called "the Oregon Country." In 1579 the Englishman, Francis Drake, came to the region seeking the Northwest Passage; and 200 years later Captain Cook, on the same quest, surveyed the coast as far as Bering Strait. These early explorers saw trees that still are standing—for the Douglas firs of the coast forests are known to have attained great age. It is not uncommon to find trees 700 years of age. Long, healthy growth results from the heavy rainfall, and lack of severe winds allows the trees to stand until cut, or to reach full maturity.

Soon after the close of the War of Independence, American merchants began to buy furs along the northwest coast and ship them to China; for years trappers and traders visited the section with more or less regularity, and ships in the China trade dropped anchor there. The Lewis and Clark expedition of 1805–06, crossing the Rocky Mountains, made its way down the Columbia River, through the heart of the fir region, to the sea. But it was not until the building of a trading post at Astoria in 1811 that the economic development of the Pacific Northwest really began, and permanent settlement even then was delayed until the establishment of the post at Fort Vancouver (now Vancouver, Wash.) in 1824–25.

Milled for a Hundred Years

There the story of Douglas fir also begins, for it was near Vancouver, Wash., in 1827–28 that the first sawmill on the Pacific coast was erected. Most of the lumber was shipped to the Sandwich (Hawaiian) Islands—and to this day those islands depend largely on Douglas fir for their lumber needs. Nine or ten years later a mill was erected at Newberg, Oreg., and one at Salem in 1840, but the first mills in Oregon to cut for more than a purely local market were built at Oregon City in 1842–43.

As capital became available with the permanent settlement of the country more mills were erected; soon shipments were going down

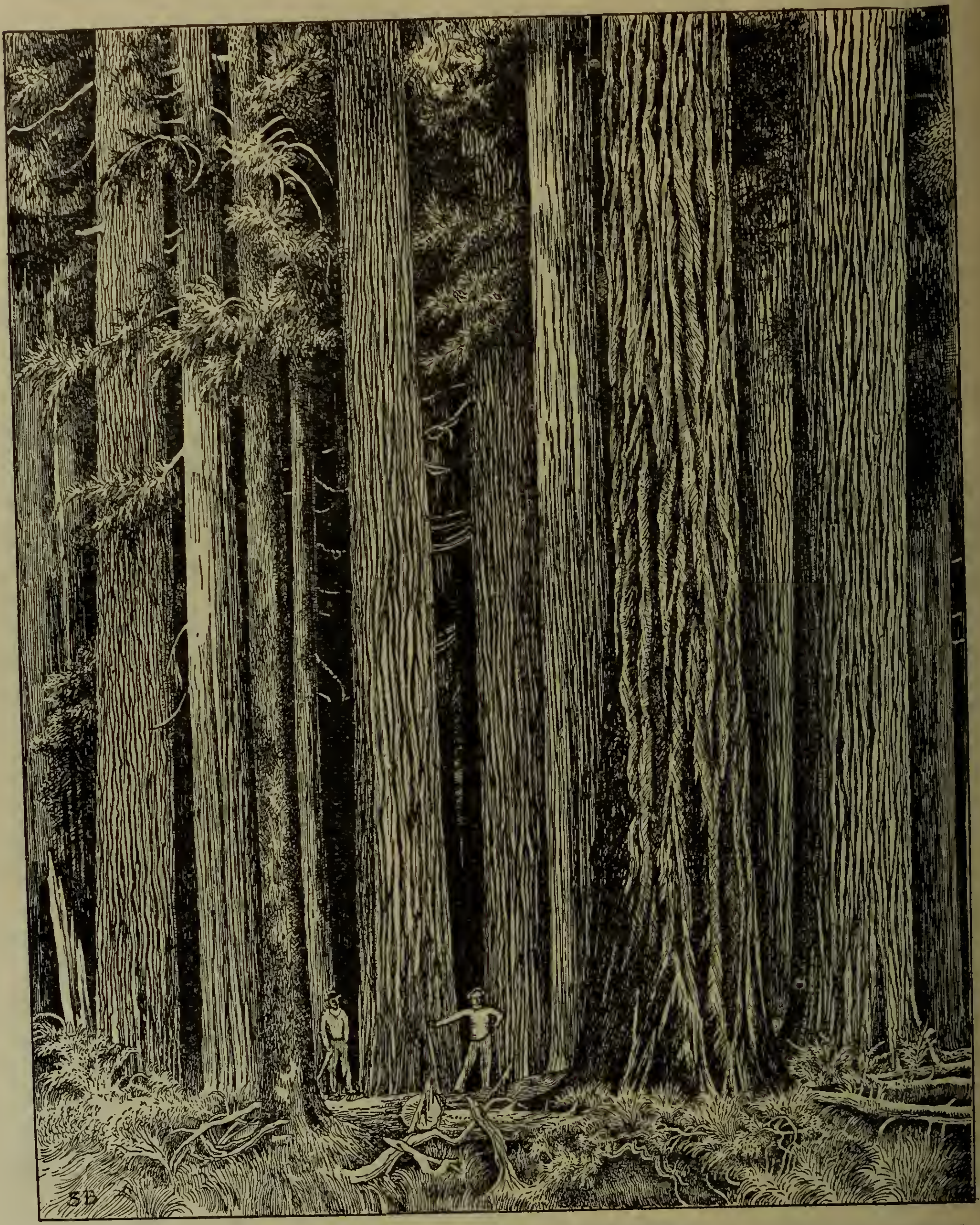

Figure 1.—PACIFIC COAST FOREST SCENE. Virgin stand of Douglas fir, hemlock, cedar, and spruce

the coast to Mexico and South America (Douglas fir still chiefly supplies the market of Peru, and even Chile's developing native lumber supply has not displaced Douglas fir in the nitrate fields) and across the Pacific to China and Japan, South Africa and Australia. With the completion of the Panama Canal—and millions of feet of Douglas fir were used in the building of the canal itself—the

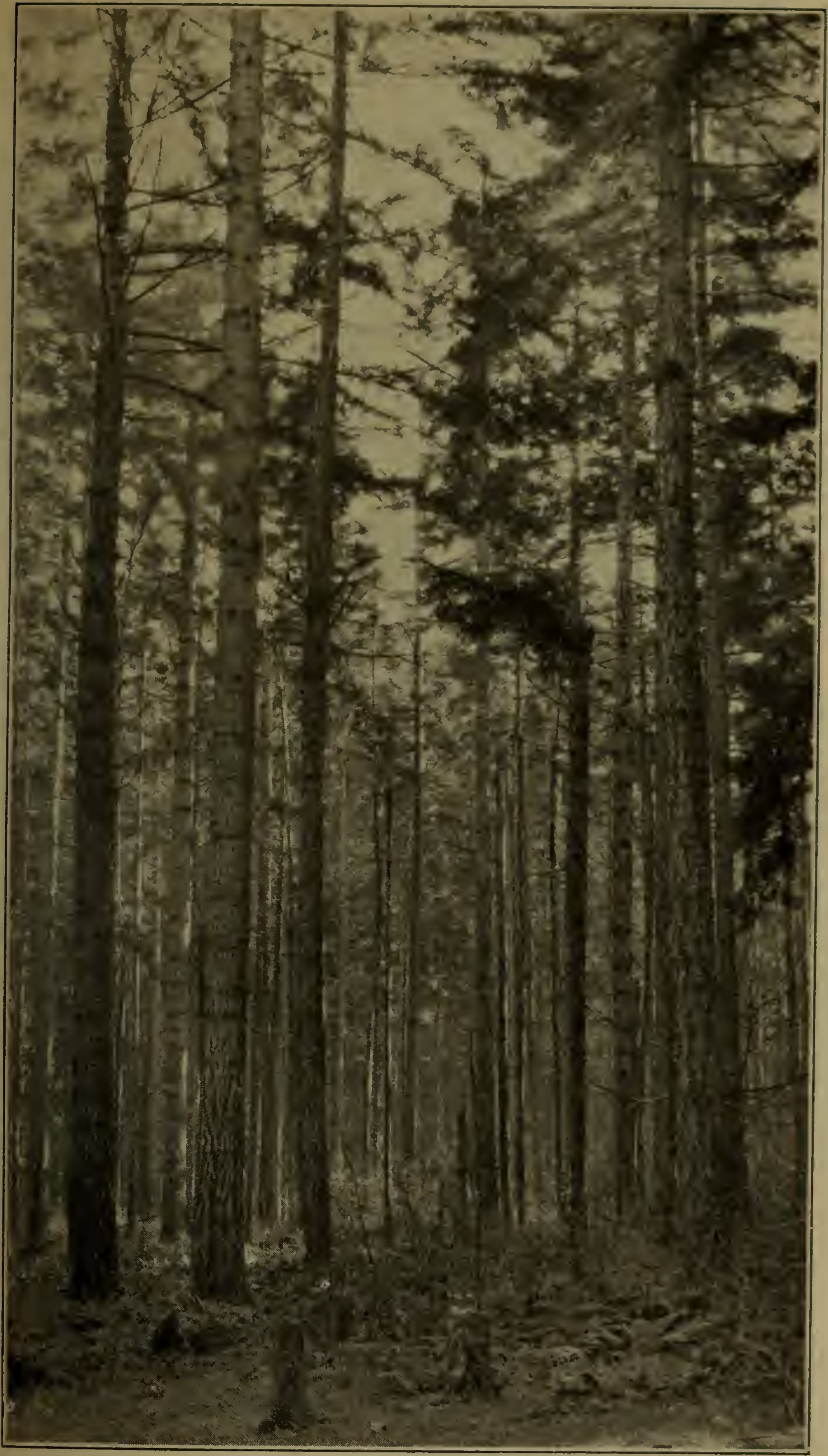

Figure 2.—DOUGLAS FIR SEVENTY-FIVE YEARS OLD, up to 30 inches in diameter, and about 175 feet high. Excellent natural conditions for tree growth bring this fine type of new growth onto lands previously cut over

markets of Europe began to take increasing quantities of the wood. Now, its distribution encompasses the globe; the whole world looks to the Pacific Northwest for masts and spars and timbers of unusual size and is taking greater quantities year by year of both structural lumber and manufactured lumber items.

Chronologically, it is but a short step from the pioneer day of the forties to now, but so great have been the strides made by the lumber industry of the Pacific Northwest that in Oregon and Washington alone it represents a capital investment of $1,000,000,000 or more, with a yearly output valued at $375,000,000. Its principal wood is Douglas fir.

Official Name

The United States Forest Service has adopted "Douglas fir—*Pseudotsuga taxifolia*" as the official designation of this wood, and that name has received the indorsement of trade, technical, and consumer associations in the United States. It is hoped that it will be universally adopted in the foreign trade as well, since multiplicity of designations will only lead to misunderstandings and disputes. While the tree was first called a pine, it is not a pine, nor a fir, nor a hemlock, but is an individual species. The wood more closely resembles pitch pine than soft pines, firs, or hemlocks, and is used for most purposes where the pitch pine is employed.

Douglas fir is a conifer or softwood. It is not of the fir (Abies) family, but is far superior to the true firs in strength, durability, and all properties and usefulness.

Douglas fir immortalizes the name of David Douglas, famous Scottish explorer and naturalist who, as field representative for the Royal Horticultural Society, visited the Columbia River in 1827 and returned with seeds for numerous plantings in Europe.

The Oregon pine (or simply "Oregon"), so named because first exports were from Oregon Territory, of the foreign market and Douglas fir are one and the same thing. Other names are applied to it locally—red fir, yellow fir, British Columbia pine, Columbian pine, Puget Sound pine—some of which have crept into foreign-market usage and complicated matters for the uninformed foreign buyer. In some markets the young "red fir" and old growth "yellow fir" are thought to be entirely different woods, yet all are the product of the same tree in Oregon, Washington, and British Columbia, the color being governed largely by the rate of the growth. There is no general difference between the tree or texture of wood in the United States or Canada; similar growth conditions on either side of the boundary produce the same quality of product, although certain districts produce denser growth texture than others, owing to local conditions.

Future Supplies Assured

The natural habitat of the Douglas fir reaches from Alaska to Mexico and from the Pacific Ocean to the Rocky Mountains. Its artificial introduction into other areas, notably Scotland and parts of continental Europe, in recent years has met with considerable success; but only small areas are planted outside the American Continent. It is in the coastal plains of Oregon, Washington, and British

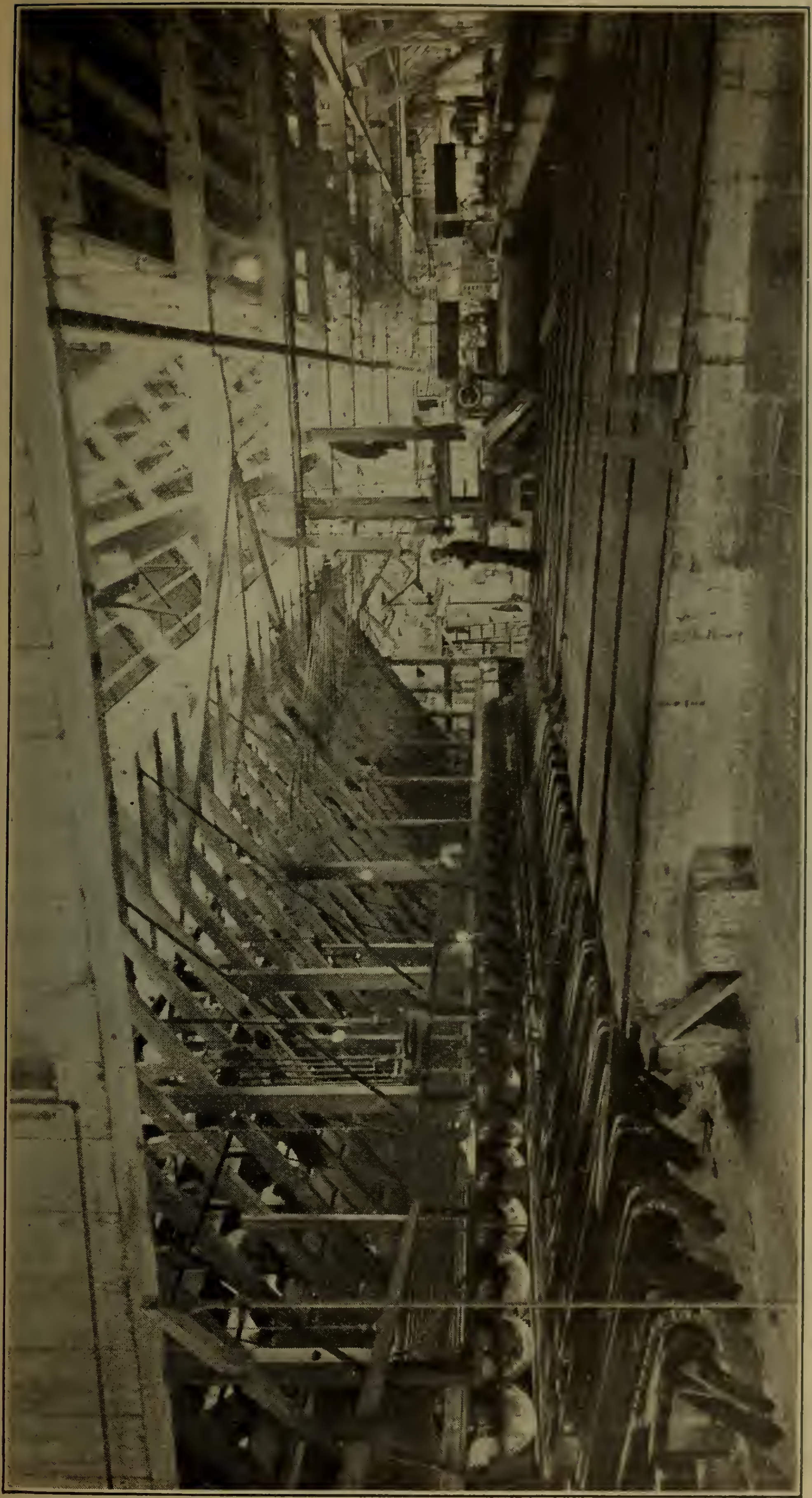

Figure 3.—TRIMMING OF LUMBER USING AUTOMATIC MACHINERY. These trimmer saws are set at a distance of 2 feet; therefore lumber cut to other lengths than those in multiples of 2 feet can not be produced

Columbia that the tree reaches its best develop
attain heights of 250 to 300 feet and girths of 30 to
so dense that at times a single acre will provide lo
a fair-sized mill for a whole day. Stands commo

State owned forests is carefully supervised and scientifi
to the rate of replacement, so that these areas will pro
time a source of Douglas fir. Logging on private land
cially controlled; but so large are the resources that
mature stand will provide lumber, even at to-day's l
cutting, for 60 years or more without taking into a
maturing in the meanwhile. This region is, therefore
as the world's largest body of softwood timber. Furth
vate owners are interesting themselves in reforestation m
new growth on private lands is approaching the cutt
that it should not be long before here, too, perpetual
be assured. Production of Douglas fir is now going o

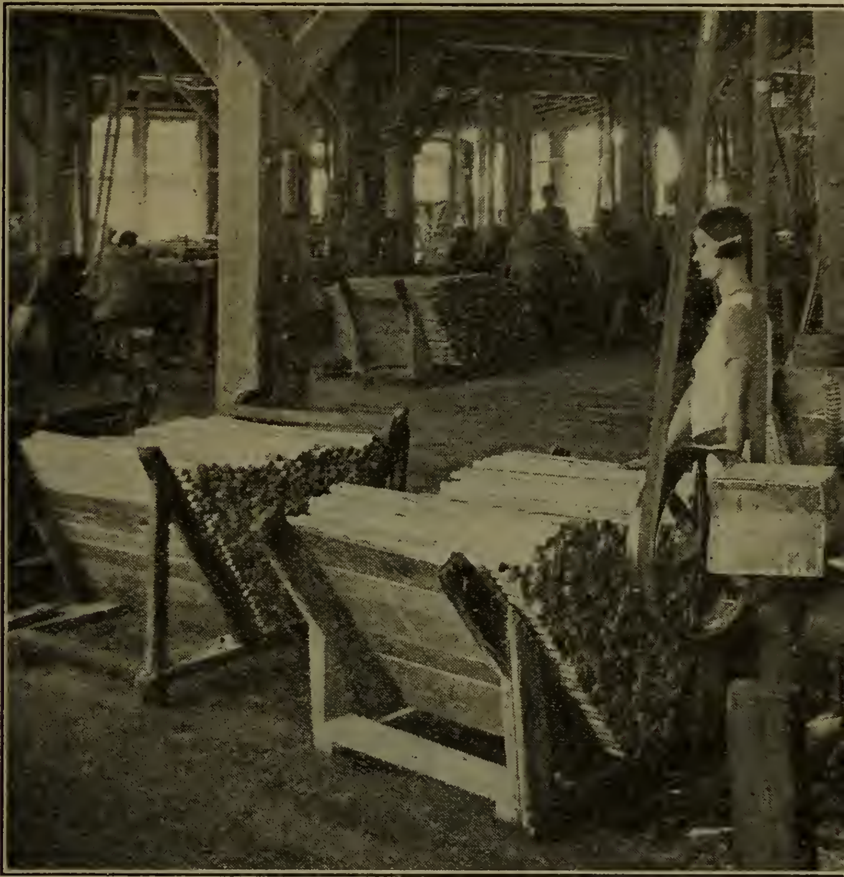

Figure 5.—BROOM HANDLES FROM SAWMILL WASTE. The m
cut-to-size stock is a growing industry in all Douglas fir sawmill

reforestation. A continual supply of timber is assured from this permanent forest region.

Douglas fir trees of the coast type reach merchantable size in 50 years without any artificial aid. They will approximate 100 feet in height and 20 inches in diameter, breast height, in 35 years; growth beyond 50 years adds nothing to the strength properties of the wood.

The coast type is distinguished by immense size and heavy stand—and density of stand has an important bearing on the quality of the timber produced, for trees which have developed in close growths are more cylindrical, their limbs are smaller, and they shed their dead branches earlier than those which mature in the open. A straight, regularly tapering stem, often branchless for 100 feet or more, is characteristic of the Douglas fir. In the eastern part of its range, in the Rocky Mountain region, where the rainfall is not abundant and where extremes of climate occur, the trees are much smaller, rarely over 1½ feet in diameter or over 90 feet high. In this section the stand ranges from 2,000 to 8,000 board feet per acre.

The present supply and assured growth of timber and the great mill capacity on deep water make the Douglas fir region a source of full cargoes of wanted sizes.

What the Wood is Like

In color the wood ranges from a decided reddish tinge to a pale yellow; hence the classification "red" and "yellow" fir. The difference is due mainly to rate of growth. In the humid coast climate trees in dense stands grow rapidly in height but slowly in diameter, and the fine-textured yellowish wood which results is yellow fir. In more open stands, with more light, diameter growth is faster, and the wider rings contain more of the dark-colored summer wood, which gives the name red fir. Since trees ordinarily grow most rapidly in youth and slow down with advancing age, red firs may become yellow firs as they grow older and the annual rings become narrower.

The wood is moderately hard but workable; is resilient, tough, durable, and practically impervious to water; holds nails firmly, and takes stain and paint well. The resin in the wood makes it durable. The grain is straight and varies from as few as 4 or 5 rings to the radial inch to as many as 45, thus giving great variety of texture and figure. Because of the very small amount of sapwood on a Douglas fir log, however—averaging not more than 2 inches on a 4-foot log—it is easy to get pieces free from sapwood, and it is unusual to find sapwood at all on Douglas fir structural timbers, except on the corners of large timbers cut from small logs. This small proportion of sapwood greatly reduces discoloration such as blue stain, because it is only sapwood which discolors. It is a reason, too, for the durability of Douglas fir, for heartwood is more durable than sapwood.

What Tests Show

Because Douglas fir is practically a newcomer on the world lumber market and has behind it not centuries but only decades of use, particular interest attaches to testing-laboratory studies of the wood. The United States Forest Service has for several years been carrying on comprehensive tests of the mechanical properties of the American commercial woods, and in its Bulletin No. 88 has this to say regarding Douglas fir:

> Analysis of the results of numerous tests to determine the relation between physical characteristics and mechanical properties of the wood shows—
>
> (*a*) That so-called red and yellow fir have practically the same strength; the yellow fir, however, contains fewer defects and is much more uniform in rate of growth.

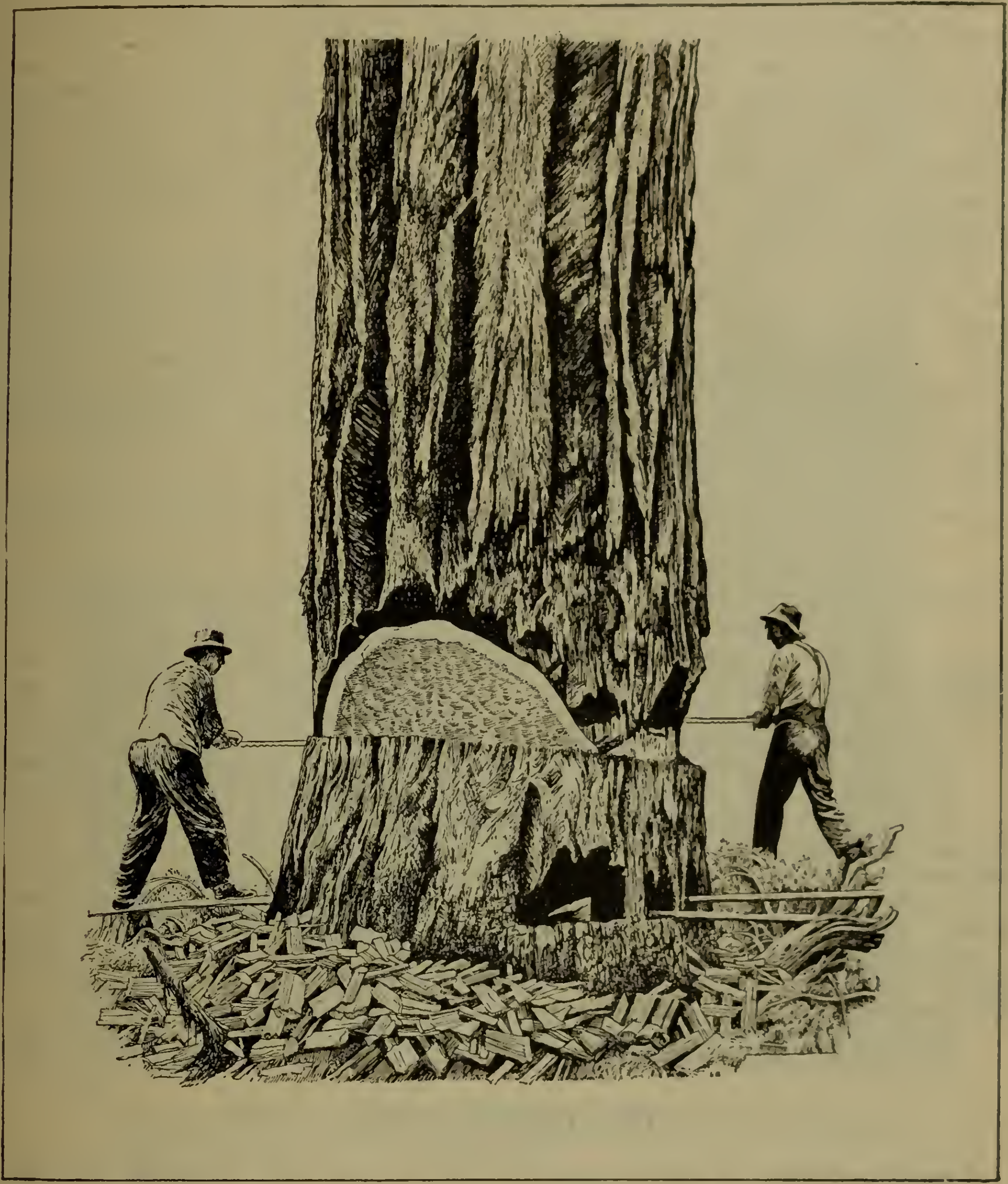

Figure 6.—FELLING DOUGLAS FIR TREE. The felling of Douglas fir logs requires special skill. This tree is more than 1,000 years old

> (*b*) The mechanical strength of wood varies directly with the dry weight: in other words, the heavier the wood the greater its mechanical strength.
>
> (*c*) The greatest strength of Douglas fir is most frequently associated with the rate of growth between 12 and 16 rings per radial inch.

In this connection see the statement of strength values that follows. Static bending value represents the effect of a slowly increasing load; impact bending, a sudden load or shock.

The values in the table are average values for Douglas fir as a whole. There is, however, a practical means of selecting, by visual inspection, the stronger material of Douglas fir of the higher range of values above the average. The late portion (summer wood) of the annual growth of a tree is much heavier, harder, and stronger than the early growth of the year (spring wood), and the greater the proportion of summer wood (the darker, harder portion of the annual ring) the stronger a timber will be.

The table gives ultimate strength and elastic limit values for small pieces free from defects. Safe working stresses are determined from these by dividing by a "factor of safety"—this factor depending on many conditions, including grade, use, exposure, and length of time and character of loading. On account of the elimination, by selection for density, of individual pieces of low strength, working stresses for stock selected for density can be materially increase.

Where the amount of summer wood is not less than one-third of the annual ring, working stresses one-sixth greater than those derived from average values may safely be used in bending and compression. The selection for density is practical of application to timbers in their original sizes or to smaller sizes resawed from them. Dense material of Douglas fir commands working stresses not exceeded by those of any other American species.

STRENGTH VALUES FOR DOUGLAS FIR (AIR DRY[1]): RESULTS OF TESTS ON SMALL, CLEAR SPECIMENS

(Prepared by Forest Products Laboratory, Forest Service, United States Department of Agriculture)

Number of trees represented in tests	29
Weight per cubic foot, pounds	34
Static bending:	
Fiber stress at elastic limit, pounds per square inch	8,200
Modulus of rupture, pounds per square inch	11,900
Modulus of elasticity, 1,000 pounds per square inch	1,940
Work to maximum load, inch-pounds per cubic inch	8.5
Impact bending: Drop to cause complete failure,[2] inches	29
Maximum crushing strength in compression parallel to grain, pounds per square inch	7,540
Fiber stress at elastic limit in compression perpendicular to grain, pounds per square inch	950
Shear parallel to grain, pounds per square inch	1,140
Hardness:[3]	
End grain, pounds	760
Side grain, pounds	670

How Logging is Done

Logging trees of such immense size as are the Douglas firs presents many problems and calls for the highest kind of engineering knowledge. Labor of the requisite skill commands high wages—and high wages constitute one of the fundamental factors of the

---

[1] From tests by U. S. Forest Service. Value for "air dry" obtained by adjusting to 12 per cent moisture results of tests made on material at from 6 to 17 per cent moisture. Bending specimens 2 by 2 by 30 inches on 28-inch span. Others 2 by 2 inches by various lengths. Moisture percentages are based on the oven-dry weight of the wood.

[2] 50-pound hammer dropped from increasing heights, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, etc., inches until complete failure occurs.

[3] Load required to imbed a 0.444-inch steel ball to one-half its diameter.

Douglas fir industry throughout all its ramifications. Offset against these high wages, however, is a low first cost of timberlands—a reversal of general conditions in other lumber-producing countries, where labor is cheap and timber high-priced. Logging railroads must be built and extensions added as the operations proceed.

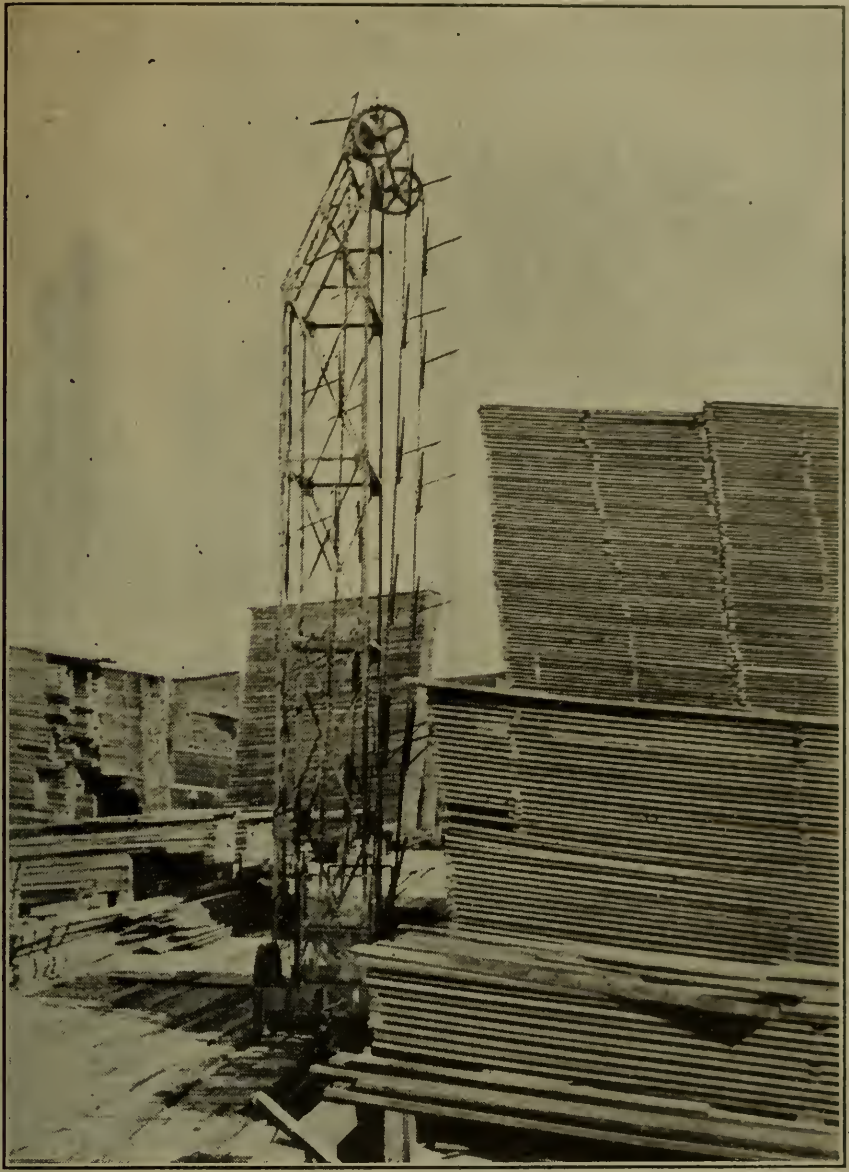

Figure 7.—LUMBER PILING METHODS AT DOUGLAS FIR MILL. High labor charges on the Pacific Coast have caused the introduction of labor-saving devices in lumber yards

Considering distances from mills, lack of roads, and inadequate transportation except the logging railroads, which very seldom can give regular passenger service, Douglas fir lumber manufacturers are put to heavy capital and operating expense for logging camps. These are sometimes portable buildings, or sometimes elaborate bunk houses, dining rooms, and kitchens, bathhouses, and reading and motion-picture rooms constructed on flat cars. At times the portable camps are long, narrow buildings designed for derrick and flat-car moving. The comforts of living, eating, and entertainment supplied "lumberjacks" add materially to investment and costs.

Logging consists in the felling of timber, bucking into logs, and transporting them to the mill. Little choice is permitted the logger in the location of his operations; he must log where the timber grows, regardless of rough country, lack of sizable streams to float his logs, and other topographical and transportation difficulties.

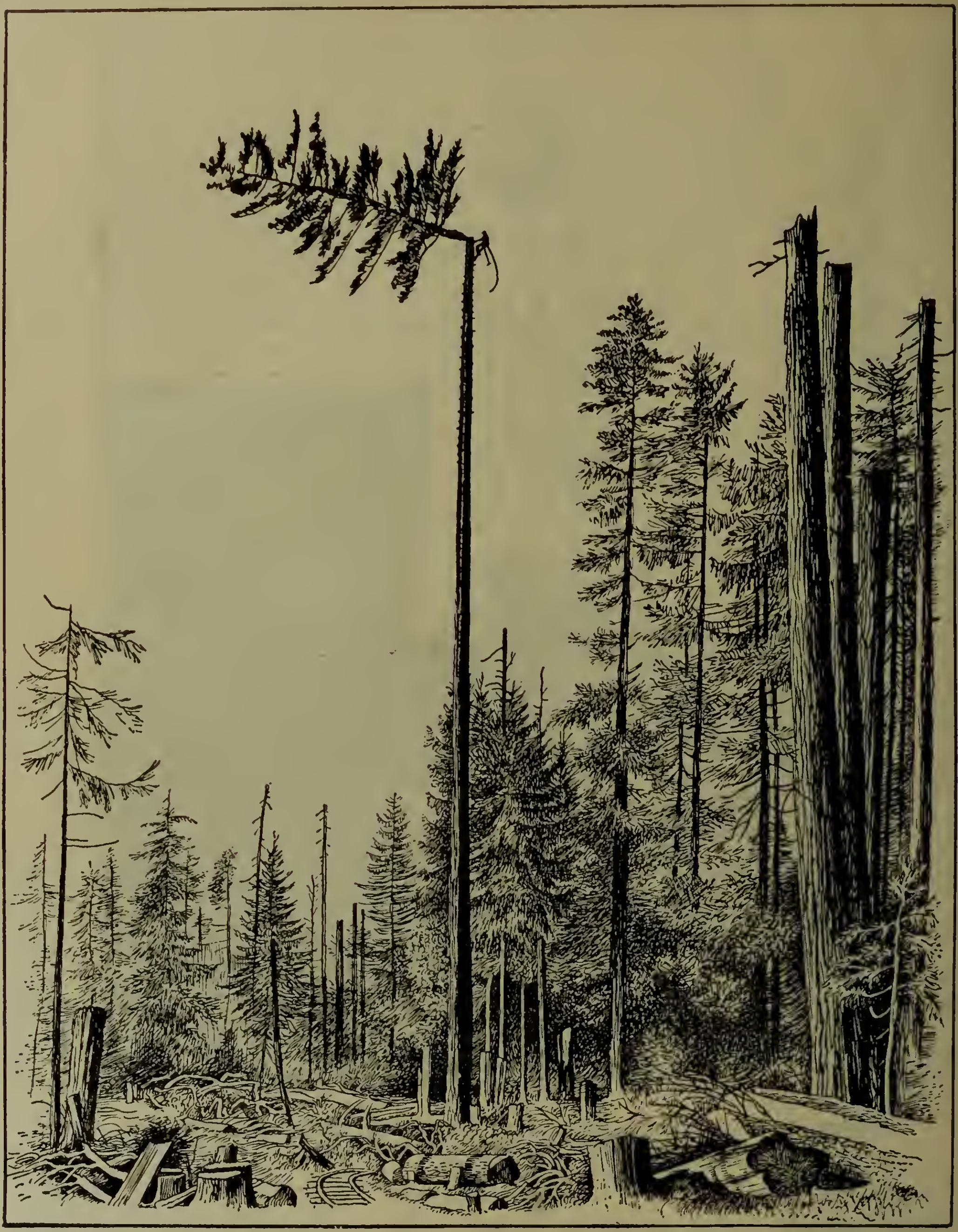

Figure 8.—TOPPING A SPAR TREE. A tall tree is selected as anchorage for heavy logging cables. The top is cut and branches removed

Felling the huge trees is done by 2-man crews with an ax-cut notch for direction of fall to avoid other trees and a double-handled cross-

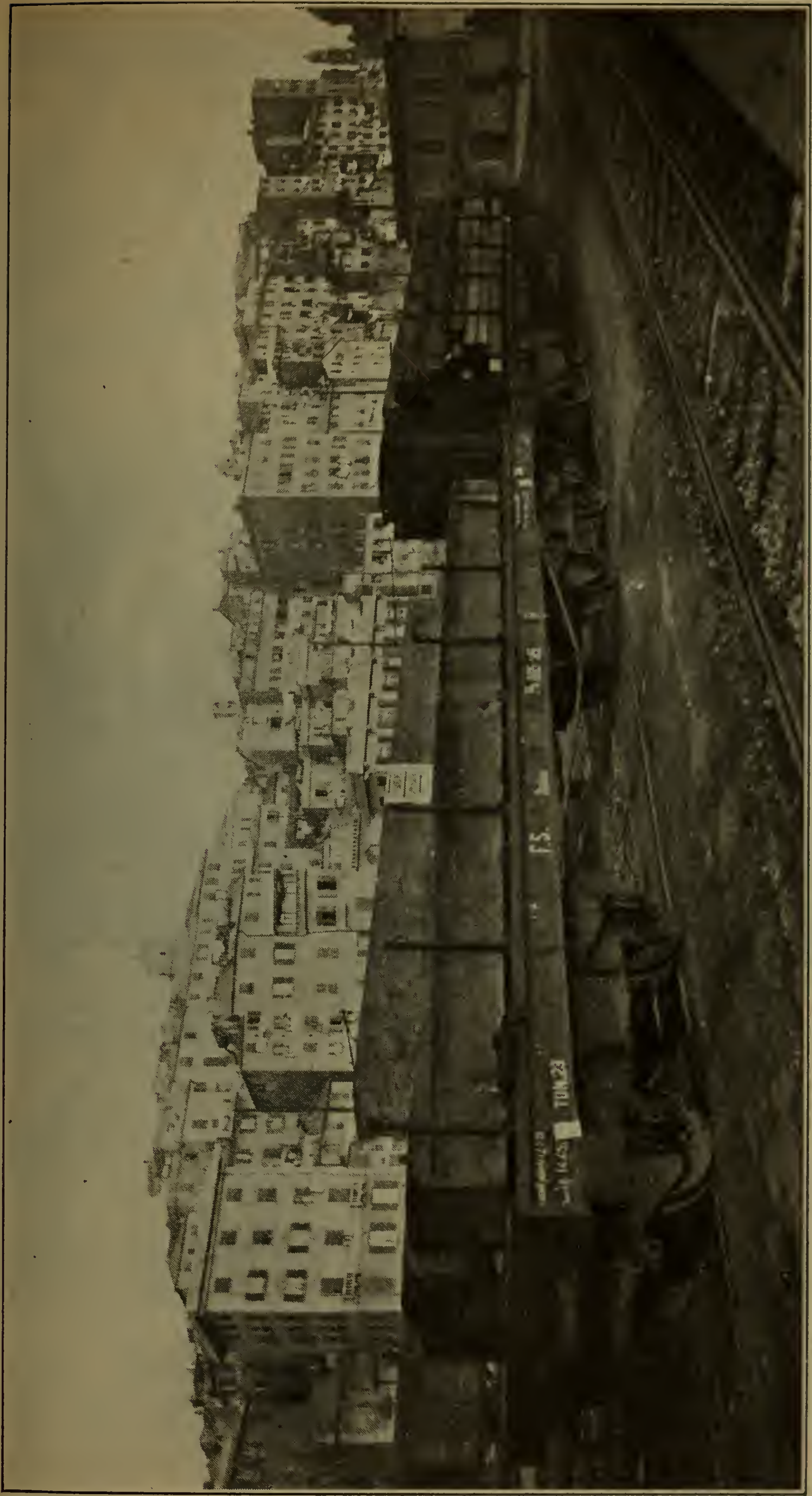

Figure 9.—DOUGLAS FIR IN ITALY. Large Douglas fir timbers in the ports of Genoa on their way to the industrial centers of Italy where this material is used for special purposes

cut saw with wedges for the greater part of the long distance through the butt. The customary lengths for logs are 24 to 40 feet, with longer or shorter lengths to fill special orders. When the log is to be dragged along the ground, one end is rounded off so that the log will slide easily over obstructions.

The costly logging and manufacture makes it unprofitable in many instances to transport to the mill logs less than 18-inch top, which usually yield less than costs.

After the logs have been thus prepared they are "yarded," which consists in bringing the logs from their original position in the forest to a central point from which they may be removed by rail or water to the mill.

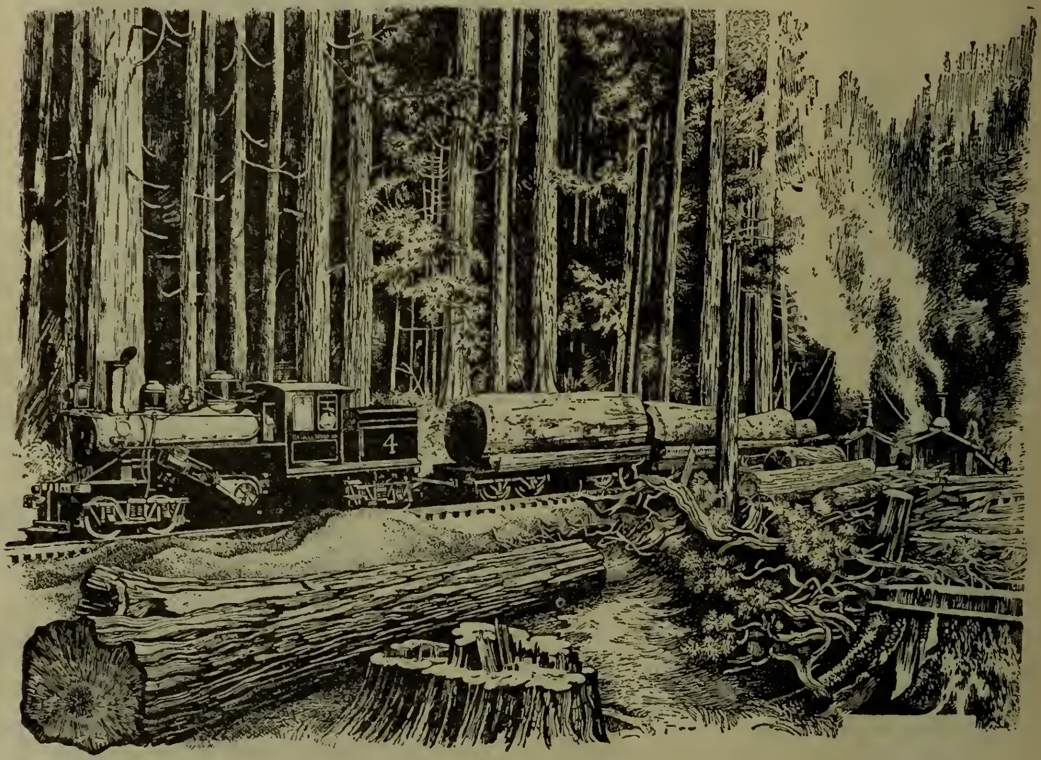

Figure 10.—LOGGING TRAIN. Sawmilling and logging in Pacific Coast Northwest usually requires heavy investment in railroad building and equipment to transport the logs to the mills

How Logs Reach the Mill

In the beginning, when stands near the coast or along the great rivers of the region were being cut, it was possible to float the logs to the mill, but as operations moved away from shore and stream, rail conveyance became increasingly necessary; in the State of Washington alone there are now 265 logging-railway companies. A large percentage of logs still are floated to the mills, but often after an initial rail haul to water.

In "ground yarding," the oldest and simplest kind, the logs are dragged on the ground by means of a cable and a stationary winding engine. Yarding may also be done by what is called the "high lead" system, which differs from ground yarding in that the hauling cable passes through a block at the top of a tall spar tree (a standing tree topped and trimmed) near the winding engine and for distances

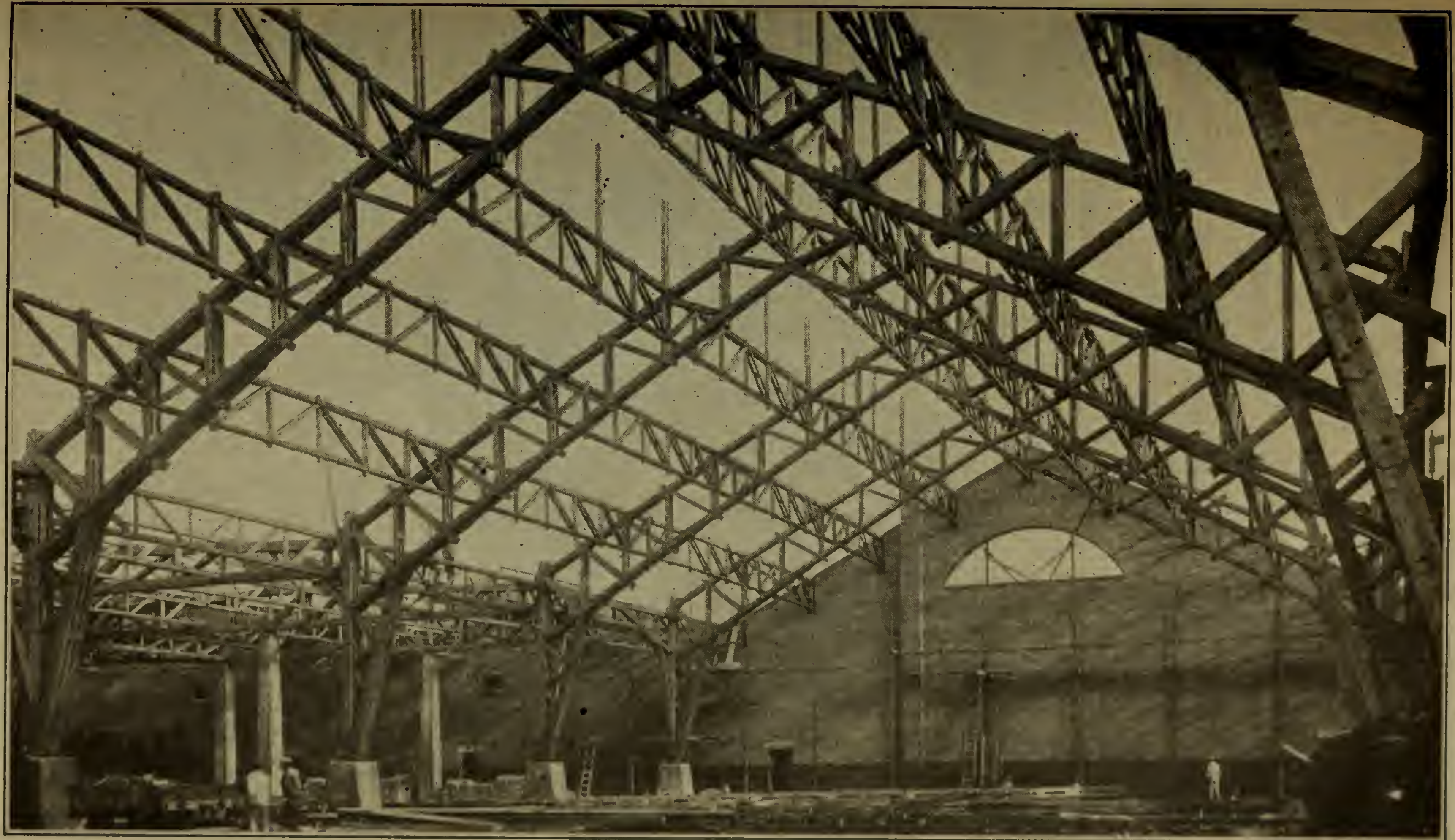

Figure 11.—ROOF CONSTRUCTION FOR INDUSTRIAL BUILDING IN GERMANY. Europe, with centuries of experience in wood utilization, makes extensive use of built-up timber construction. Douglas fir is now gaining ground for these purposes

up to 600 feet or more permits the end of the log to be lifted off the ground and kept from catching on obstructions; it also is possible to haul several logs at one time by this method. A third type of yarding is the overhead system, where the logs are transported by means of a cable, suspended between spar trees, with a running carriage connected to the winding engine; by this method not only may several logs be moved at one time, but a much larger area may be yarded without changing the location of the engine.

Yarding brings the logs up to the logging railway, but there, as with felling and yarding, the huge logs present a problem, for heavy cables must be used, with steam or electric power; both cranes for loading and the railway must be not the flimsy, bedless track of the usual forest working, but of solid construction and substantial equipment to bear the weight of the huge logs. Loaders are often mounted on "tunnel" cars—railroad trucks that straddle the train of log cars. The use of oil and electricity for power in logging is increasing, since they avoid forest-fire hazard from smokestacks.

To transport the logs to the mill by rail, standard-gage railways have been found most advantageous, inasmuch as connections with the regular commercial railways are frequent. This means heavy investment of capital in roadbed, track, and bridges, and capital investment in logging railways should increase rather than diminish as felling is pushed farther and farther into the interior.

Northwest waters are the large Puget Sound and wide rivers, the Columbia River being the largest. The great water areas carry ocean tonnage, and logs must be assembled in heavy rafts, strongly bound with chains, and tugs must be used. Simple floating of loose logs to mill is possible in very few places in the American Northwest.

Parenthetically, it might be remarked here that transportation from mill to export market presents no costly problem. The location of so many of the largest export mills on or near tidewater puts cheap water carriage virtually at their doors. The foreign buyer of mill products is, in fact, often more favorably situated as regards transportation costs than is the American inland buyer, who receives his lumber after a long rail haul.

Mills are Large and Complex

The first lumbering enterprises in the Douglas fir region were small, simple sawmills producing only rough, green lumber. While a number of small mills are still in operation, there has been a gradual change in the representative type until now the typical mill is a large, complex plant composed of many units and equipped to turn out lumber products in a variety of conditions and forms and in large quantities. They can not operate advantageously on small orders or unusual dimensions. Mass production—the manufacturing of large quantities of standard sizes—is the keynote of their operating policy.

The early mills were principally "cargo mills," so called because they were built to supply lumber by the vessel load to domestic and foreign ports. To-day three types of mills are recognized; the strictly cargo, the strictly rail, and the combination mill.

Over 80 per cent of the lumber produced in the Douglas fir region is manufactured at plants ranging in daily producing capacity from 75,000 to more than 1,000,000 board feet. The usual size of the larger type is probably between 150,000 and 200,000 board feet in 8-hour capacity, although there are many successful smaller mills supplying sawed ties and the small structural timbers. The vast amounts of capital which have become available for sawmill construction in the past two decades have played an important part in creating the trend toward large plants equipped to turn out the more finished products. Besides saw and planing mills, there are often box factories, sash and door factories, and pulp and paper mills as parts of the mill organization.

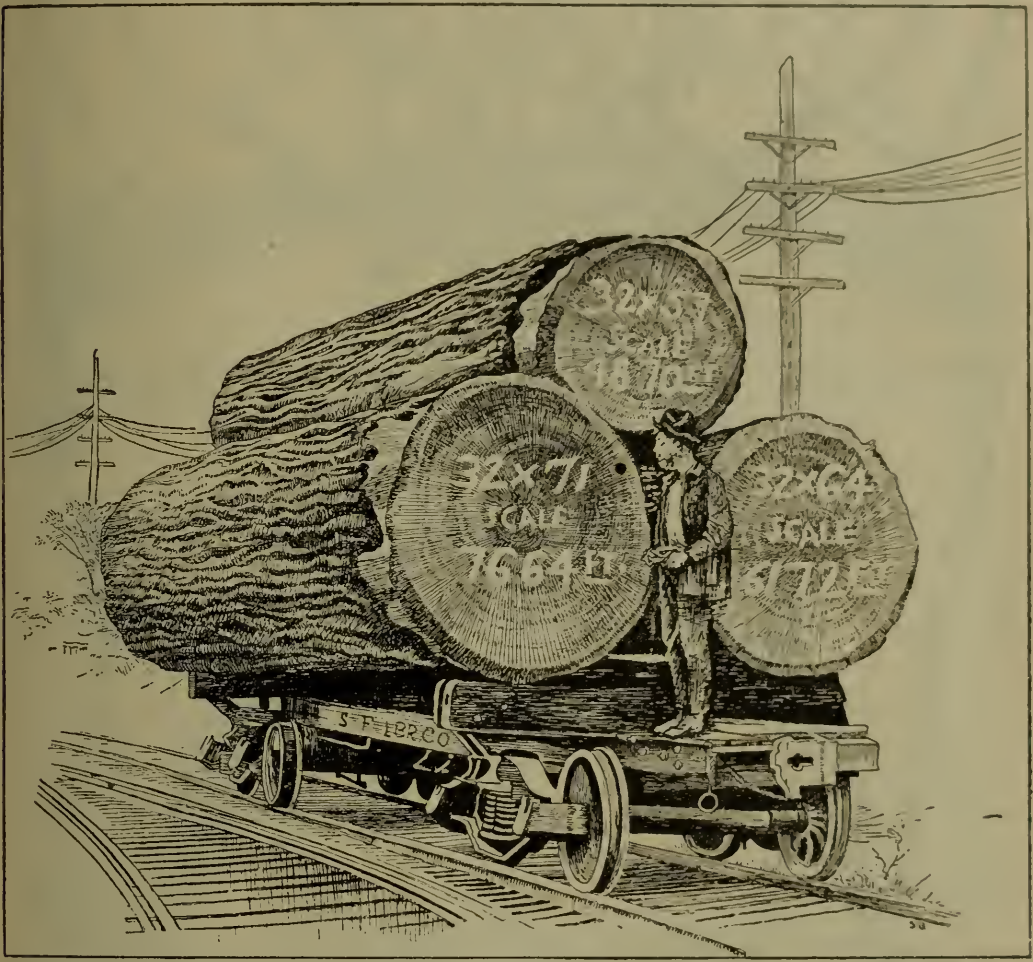

Figure 12.—CARLOAD OF LOGS. The transportation and logging of huge Douglas fir logs are difficult problems for the sawmill operators

Diversified large output is the function of a Douglas fir mill. Marketing calls for numerous sizes and products, and profit accrues from maintained large production. Mill and crew are arranged to yield continuously so much in timbers, rough or planed boards, flooring, ceiling, siding and numerous patterns, and various specialties. Every machine, every man, is only a cog in the wheel; everything must go like clockwork, for, if one fails, dozens of men at $4 and $5 per day stand idle. Standardization, as far as possible, is necessitated by heavy investment and high operating costs, and has been so carefully and thoroughly worked out as to cover the bulk of the production and practically all uses of lumber. Special orders and special requirements are readily supplied, however, at the additional cost required for handling.

How Douglas Fir Lumber is Manufactured

Owing to the great size of Douglas fir logs, the mills are of heavier construction and the equipment much larger and stronger than in most other lumber-producing regions. The necessity for giant machines is apparent when it is explained that logs weighing 3 to 5 tons are elevated 30 to 40 feet, reduced to cants, the cants cut to board or other sizes, and the resulting pieces trimmed to desired lengths—all in the space of five or six minutes, with every log and piece of lumber handled by machinery. At the same time 1 to 3 tons

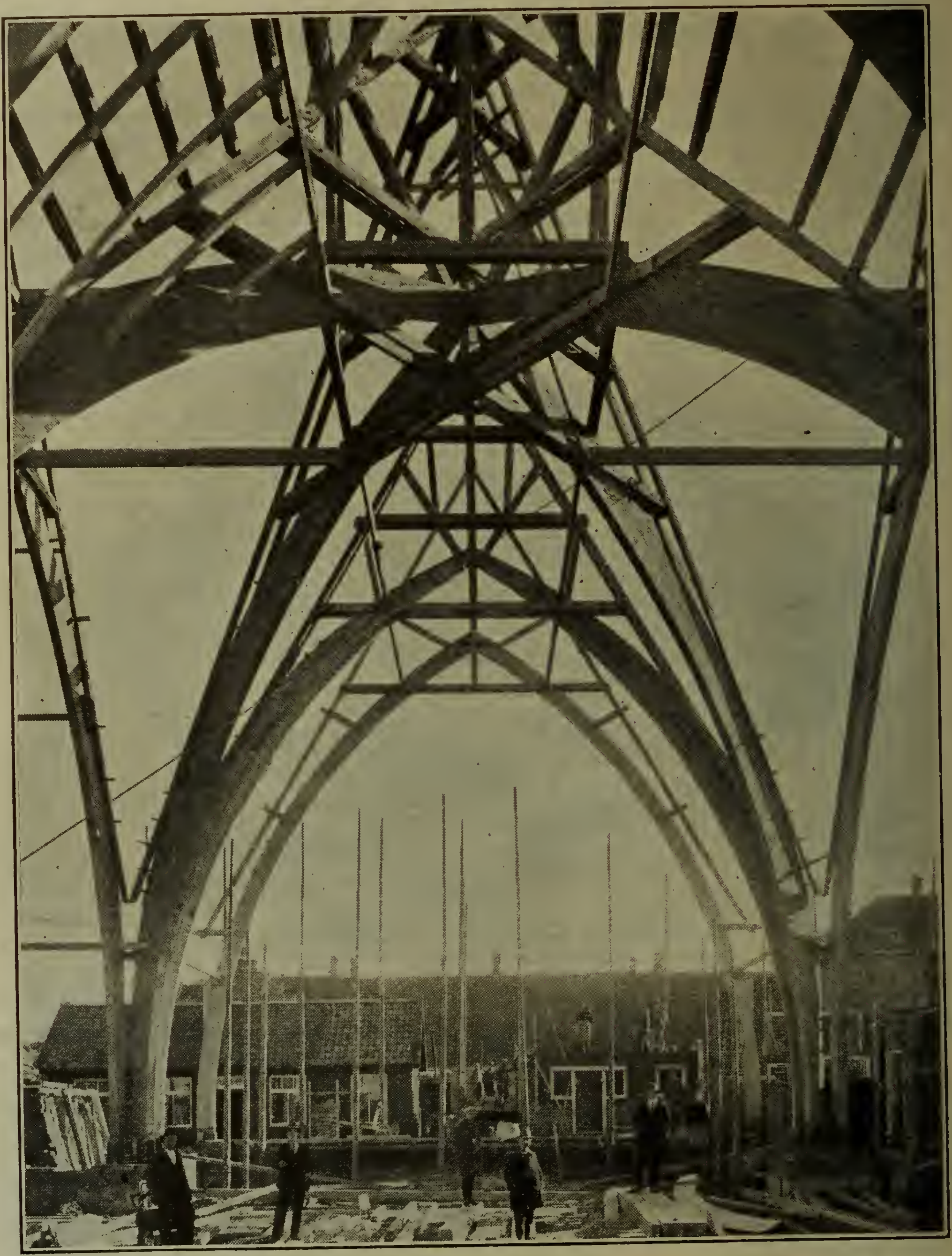

Figure 13.—WOOD CONSTRUCTION IN THE NETHERLANDS. The utility of Douglas fir for truss construction is well known to European architects and engineers

of sawdust, slabs, and waste wood and bark are mechanically conveyed to boiler, lath mill, and refuse burner. To describe the process briefly:

At the mill the logs, which have been stored in the mill pond until wanted, are drawn up an inclined way to the log deck, whence they move to the saws. Originally the old circular head saw was universally employed for the main sawing operations, but at present the band type is most used.

The log is usually only partly cut into lumber on the head saw. A slab is first cut off, then the clear lumber near the surface of the log is cut into cants (pieces intended for further sawing) and next the common lumber in the interior is cut into cants or timbers. The system used is to separate clear lumber on the outside and turn the log when defects appear. After a slab and one or more cants have been cut from one face, and the log is turned, another slab and more cants are cut from the fresh face, and the log is turned again—maybe half a dozen times. The turning is done by compressed-air or steam appliances.

Any boards cut by the head saw go to the edger, where they are cut into the desired widths and wane (bark) edged off. The cants, which usually are cut by the head saw to a thickness just equal to the width desired for the finished lumber, are run through a gang saw, the resulting lumber seldom requiring edging. After the lumber has been cut to the wanted width and thickness, it is trimmed to proper lengths, in multiples of 2 feet. This work is done by an operation of a key board that controls spaced circular saws hung over a conveyor. From the trimmers the lumber is carried to the sorting chains, where each piece, which as it left the trimmer was marked with its grade or the disposition to be made of it, is sorted and placed on trucks with other pieces of the same grade and size for transportation to the mill yard, kiln, cars, or docks.

Boards are usually kiln-dried before going to the planers. Some grades—for example, for cutting out door and sash stock—are only dressed. Fast-feed matchers make flooring, siding, or ceiling, or S4S (surfaced or dressed on all four sides) for finish, casing, shelving, and similar uses. Many mills have molding machines which utilize the narrow strips. After passing through the planers the lumber is trimmed and graded, and then all except the finish is made into bundles, usually of six pieces, after which it is taken to a storage shed to await shipment.

The various products and forms into which Douglas fir is manufactured can be classified into two main groups—planing-mill patterns and stock that is only sawn or only sawn and dressed. The proportion of each of these two general groups in any mill's daily output varies directly with the ratio of clear to common grades of lumber in the logs fed to its saws.

Comparison of American and Foreign Sawmill Practice

It must be recognized that higher stumpage prices with lower labor costs in Europe compared with low stumpage prices and high labor costs in America must influence sawmill practice. American forest taxes are still mostly annual, with good progress toward yield taxes; mills' overhead and fixed charges never stop; these things require mills to keep operating, for it would cost $5,000 to $10,000 to shut down in some cases.

Conditions in other lumber-producing countries favor very careful manufacture, whereas costly labor on cheap material in America has forced the development of speedy processes. To this end American machinery has been designed for rapid feed, and it must be admitted that this is not always entirely consistent with exact manufacture. While American sawmill practice in the future undoubtedly will be changed to decreased speed and more accurate manufacture, for some years to come American lumber manufacturers will be forced to balance their operating costs against the value of material and adjust the speed of the machines thereby. However, the foreign buyer should realize that the comparatively low delivered price of the high-quality lumber obtainable from America is due largely to the fast feed of our machines, because our high labor costs under present conditions will not make slower speed profitable. As an indication of American costs average earnings of employees per 8-hour day in Washington mills during 1925 were as follows: Sawyers, head, band, $9.12; doggers, $4.04; setters, $4.75; sawyers, gang, $5.32; sawyers, resaw, $4.91; edgermen, $5.60; trimmer operators, $5.22; machine feeders, planing mills, $4.32; and common laborers, $3.82.

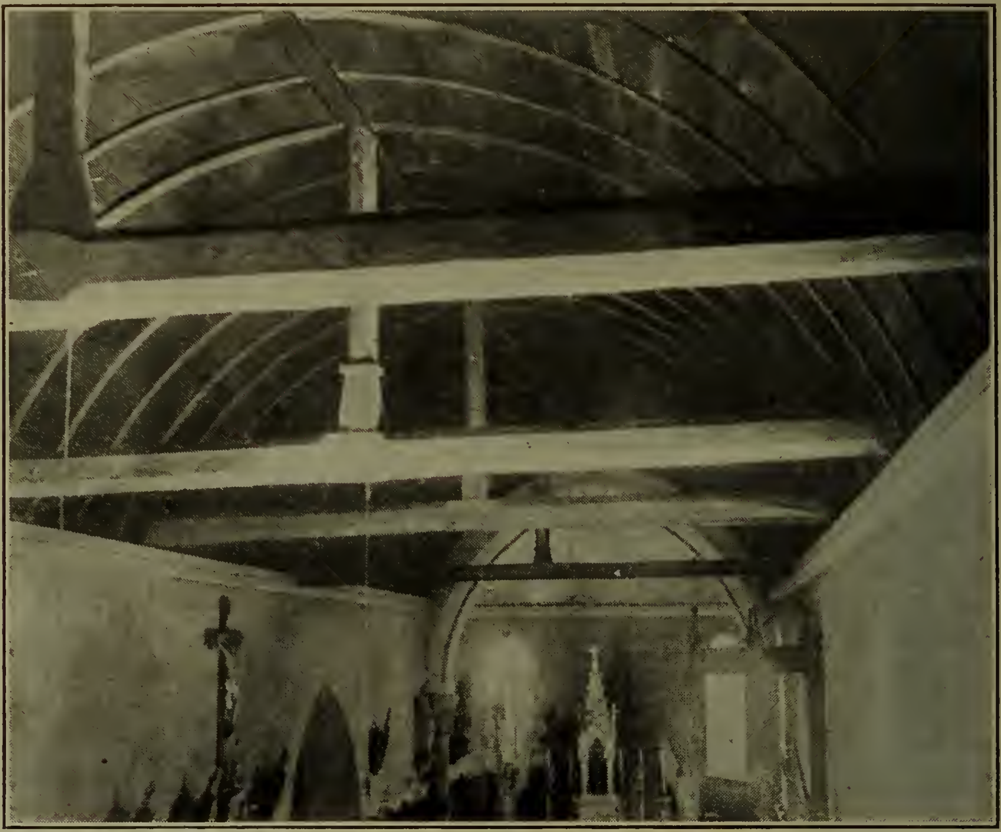

Figure 14.—DOUGLAS FIR IN ELEVENTH CENTURY CHURCH OF ST. MARCEAU IN NORMANDY. Through the utility and beauty of Douglas fir, this 700-year-old church was restored

Proper Inspection and Measuring Provided

In addition to the men who actually handle the lumber or run the machines, there are inspectors, commonly called graders or tallymen, who grade and measure the lumber. All lumber must be sorted for grades. Most of the cargo mills of the west coast have united to form the Pacific Lumber Inspection Bureau (generally referred to as the P. L. I. B.), which furnishes tallymen who grade and measure lumber shipped by water. The inspectors of the bureau make affidavit before a notary public of the correctness of grade and measure. This certificate and "tally" (measure) are attached to the invoice. The P. L. I. B. certificate is generally accepted among buyers and sellers of water-borne Douglas fir lumber as assurance of correct grades and measure.

Cargo shipments are not loaded by the mill crew except in those instances where the mill operates its own boats. Ordinarily the lumber is transported to the docks and stored there until the arrival of the vessel that is to carry it to the foreign port. Sometimes the lumber is left on the trucks, but more frequently it is close piled along the dock within easy reach of the ship's tackle. The grading and measuring by the P. L. I. B. inspectors usually are done while the shipment is being assembled on the dock or as it is being loaded aboard ship.

Douglas Fir Grades for Export

The export grades for Douglas fir are issued in schedule N, Export Basic Schedule and Grading Rules, etc., of Douglas Fir, Pacific (West Coast) Hemlock, Sitka Spruce, and Western Red Cedar, edition of 1929, printed and copyrighted by Pacific Lumber Inspection Bureau (Inc.), Seattle, Wash., and distributed by all Douglas fir exporters to foreign buyers. The grades of Douglas fir are as follows:

- General grades:
  - Merchantable.
  - Selected merchantable.
  - Common.
  - No. 3 and better, common.
- Rough green clears:
  - No. 2 clear and better, edge-grain.
  - No. 2 clear and better, flat-grain.
  - No. 3 clear, edge and/or flat-grain.
- Flooring, 3, 4, and 6 inch, kiln-dried:
  - No. 1 clear, edge-grain.
  - No. 2 clear, edge-grain.
  - No. 3 clear, edge-grain.
  - No. 2 clear and better, edge and/or flat-grain.
  - No. 3 clear, edge and/or flat-grain.
- Flooring, 3, 4, and 6 inch green:
  - No. 1 clear, edge-grain.
  - No. 2 clear, edge-grain.
  - No. 2 clear and better, edge and/or flat-grain.
  - No. 3 clear, edge and/or flat-grain.
  - Merchantable.
  - Common.
- Ceiling kiln dried: No. 2 clear and better, edge and/or flat-grain.
- Rustic and drop siding, kiln-dried: No. 2 clear and better, edge and/or flat-grain.

- Ship plank.
- Decking.
- Flooring strips, rough, green: No. 2 clear and better, edge-grain.
- Door stock, rough, kiln-dried:
  - No. 1 cuttings.
  - No. 2 cuttings.
- Pipe stock, green, flat-grain.
- Stepping, green: No. 2 clear and better, edge-grain.
- Masts and spars, sawn or hewn.
- Tank stock, edge and/or flat grain.
- Railroad ties (sleepers) and crossings.
- Mining timber.
- Pickets.
- Staves:
  - No. 1 staves.
  - No. 2 staves.
- Lath.

Seasoning of Douglas Fir

Much sawn Douglas fir going to foreign markets is shipped unseasoned—all of the sawn timbers and rough lumber in the larger sizes, because of the very slow air seasoning in the Northwest, owing to the long seasons of heavy rainfall. There is little sapwood, and the large proportion of heart prevents discoloration of unseasoned shipments. Since seasoning prevents shrinkage, checking, and warping when the wood is put in use, some lumber is air-seasoned and increasing amounts are kiln-dried. Foreign buyers of unseasoned stock for remanufacture would be well advised to follow this practice, and properly pile their stock, under roof boards or cover, for air seasoning if dry-kilning is not contemplated. For buyers' guidance, the following instructions for piling Douglas fir lumber for seasoning from United States Forest Service, are given.

> Proper piling is of greatest importance in air seasoning. Two general types of piles are found in yards of the Douglas fir region; those in which a portion of the stock overhangs the rear stickers (overhang pile), and those in which the ends of the boards are practically flush with the front and rear stickers (box piling). Box piling is employed only to a limited extent. Both methods are satisfactory. Box piling is confined largely to lumber of uniform lengths. Piles more often range from 14 to 18 feet in height. The general practice is to build the piles so that they lean slightly toward the yard alley, or with a pitch of 1 inch to each 12 or 16 inches in height. General practice is to self-stick all the yard piles. This increases their capacity and eliminates the necessity of carrying stocks of stickers, which depreciate considerably. The general practice of the region is to pile one layer of boards to a course, each layer being separated by stickers. All species are flat piled except that in a few cases 2 by 4 inch stock is edge piled.
>
> Due to practice of low piling, chimneys are seldom employed. General practice is to roof all yard piles. There are two general types of roofing, single-length and double-length roofs. The latter is in common use. It consists of two layers of battened boards, the upper layer overlapping the lower from two-thirds to three-fourths its length. It overhangs the front and rear of the pile from 24 to 40 inches; it prevents rain from beating in and drains all water clear of the stock at the rear. A height of 8 to 10 inches in front from the top layer of boards is ample for the roof.

The heavy rainfall in the Northwest and the rough, rocky country restricting mill and yard sites make air seasoning difficult. Because of the marked variation in the humidity of the atmosphere during different months, the rate of drying is not uniform throughout the year. Again quoting from Forest Service:

In the Douglas fir region air seasoning under the best conditions will not give a moisture content sufficiently low for all forms of lumber, and weather conditions are such that during a large part of the year drying progresses slowly. Lumber exposed to the late spring and summer atmosphere dried rapidly. From September to April drying occurred very slowly, the moisture content of the lumber seldom dropping below 25 per cent. During the more favorable time of the year drying progressed rapidly up to the time the lumber reached a moisture content of about 20 per cent, after which it slowed up perceptibly. Moisture content of air-dried Douglas fir averages 16 to 18 per cent. The date the stock is put up, the moisture content to which it is dried, and its thickness all have a marked effect on the time it must be left in the pile. At best it takes considerable time to air-season Douglas fir. Depending on the month when piled, it takes from 15 to 222 days to dry 1-inch stock to a moisture content of 20 to 22 per cent, and from 40 to 269 days to a moisture content of 14 to 16 per cent.

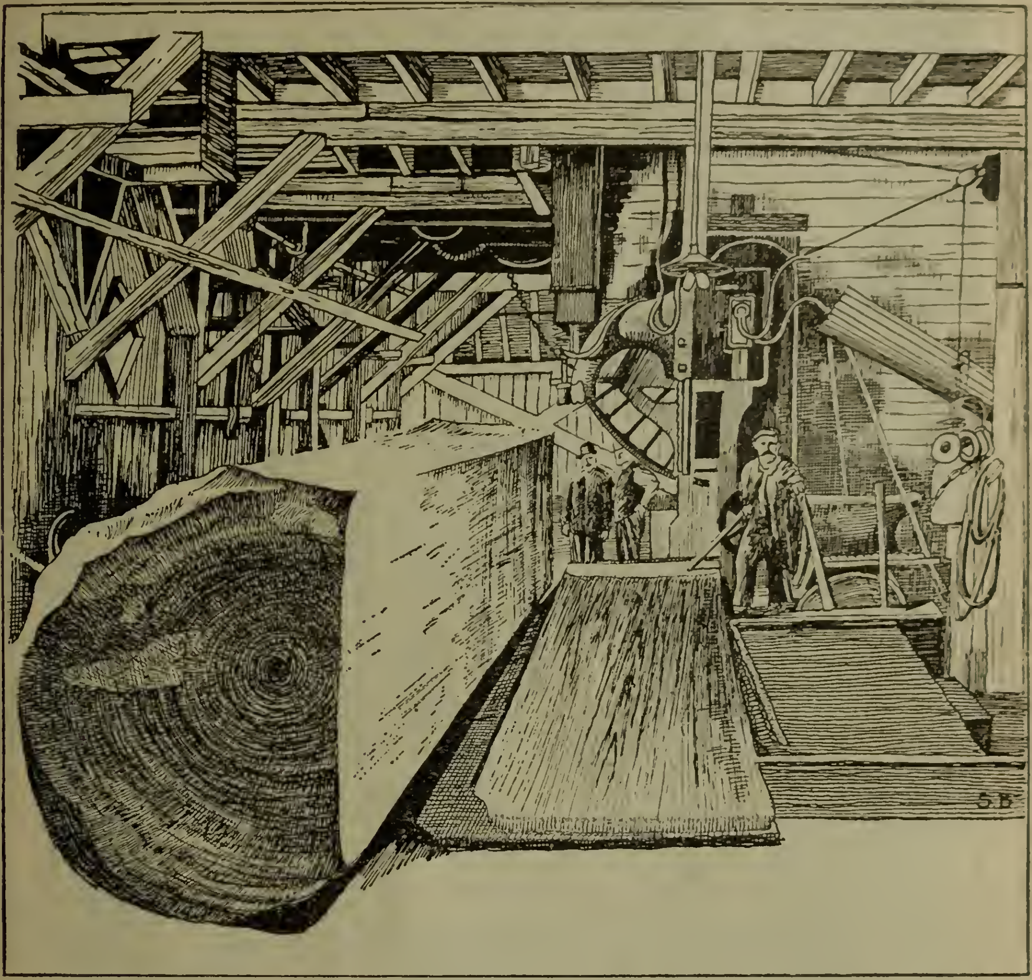

Figure 15.—SAWMILL INTERIOR. These huge logs require special machinery and automatic handling devices. The logs are never touched by human hands

Douglas fir seasoning in dry kilns is rapidly increasing. A dry kiln is a chamber with air-tight doors, tracks for lumber trucks, heat equipment—usually steam and humidity controls. Equipment and operation are adjusted for 1 inch, 1½ inch, and other stock, and the time required in days is about equivalent to the number of months needed for air drying.

The technique of kiln drying is too detailed to be given here entirely. Since No. 2 clear and better is often shipped seasoned, it seems

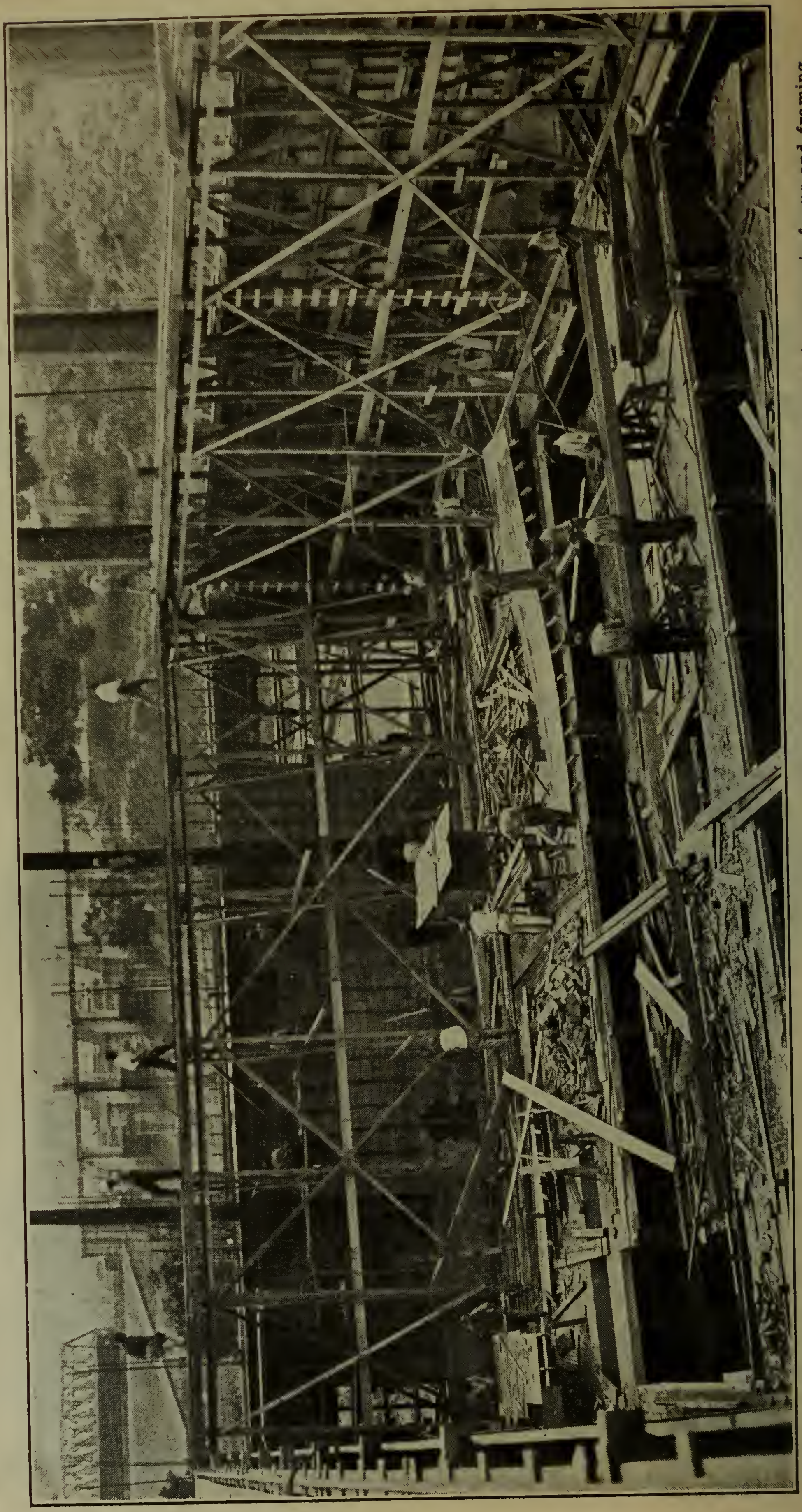

Figure 16.—**DOUGLAS FIR USED IN PANAMA CONSTRUCTION WORK.** Douglas fir is widely used abroad for concrete forms and framing

desirable to give the buyer abroad United States Forest Service advice on kiln-drying Douglas fir common grades of lumber (from U. S. Department of Agriculture Bulletin No. 1136, 1923):

> The kiln-drying of Douglas fir common is a problem quite different in several respects from most seasoning problems. One of the most important considerations is to keep the knots from falling out, and another is the fact that it is not necessary to dry the stock lower than about 15 per cent. This latter makes it much easier to keep the knots from falling out, but brings the added complication that it is very difficult to dry a load of mixed heart and sap to a uniform moisture content as high as 15 per cent. To prevent excessive shrinkage of the knots it is necessary to obtain a high humidity throughout the drying. The maximum temperature is more or less definitely limited because it is undesirable to use temperatures high enough to melt the resin from around the knots. The need for reasonable uniformity in moisture content at the end of the run and the use of high humidity make it necessary to have a very rapid and uniform circulation readily reversible in direction, and an accurate control of temperature and humidity.
>
> Douglas fir common schedules were developed in a semicommercial unit of the Forest Service internal-fan kiln, and this is the only type which can at present be safely recommended for this class of work. A constant temperature of 175° F. may be used throughout the entire drying period. In the case of 1 by 6, 1 by 8, 2 by 4, and 2 by 6 inch stock, the humidity may be kept constant at 70 per cent. For 1 by 10, 1 by 12, 2 by 8, 2 by 10, and 2 by 12 inch stock it is better to use a humidity of 80 per cent for the first half of the run, dropping then to 70 per cent. The drying time will vary considerably with the size and shape of the stock. For 1 by 8-inch material it should be about 32 hours, with a final average moisture content of 15 per cent.

Figure 17.—SAWMILL EXTERIOR. Over one-half of the cut of Douglas fir is produced in mills located on deep water

The proper seasoning of lumber by air drying or kiln drying is set forth in the bulletins on Seasoning, Handling, and Care of Lumber, issued in 1928–29 by the National Committee on Wood Utilization.

Special Specifications not Economical

Buyers overseas should remember that Douglas fir lumber is manufactured for a domestic market taking 7,000,000,000 feet a year and foreign markets taking nearly 1,500,000,000 feet. If a mill cuts to special sizes, it must be prepared to sell off-size lumber locally; this is not possible because American consumers have long since agreed to standard lumber sizes, many having discontinued their own special sizes to realize the many savings in standard stock. Most mills cut for both domestic and export and, as previously stated, investments and costs require standardized products. These standards are not exactly comparable with all sizes abroad. Lengths are multiples of 2 feet, such as 8, 10, and up to 24 feet in boards, and up to 40 feet for planks, and to 100 feet for timbers. Widths are, in inches, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16 for boards and the same, omitting 2 inches and adding 18 inches and 20 inches for planks. Thicknesses are 1, 1¼, 1½, 2, 2¼, 2½, 3, 4, and 5 inches. For timbers, sizes are 6 by 6, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24 inches, 7 by 7 inches, etc., 8 by 8 inches, etc., and up to 24 by 24 inches. Even widths are more commonly produced than odd. In an order for random widths there would be more even widths than odd, and for specified odd widths there would be a slight increase in price over specified even widths. (Random widths are various standard widths as produced.) Other sizes can at times be supplied by some mills, but only at a premium for changing operations in the mill for the time needed to cut the order, and since this slows up every part of the mill, it is not economical. Rather, the buyer might well save the premium on special stock and specify standard sizes which always sell at current market prices. (For short lengths see p. 51.)

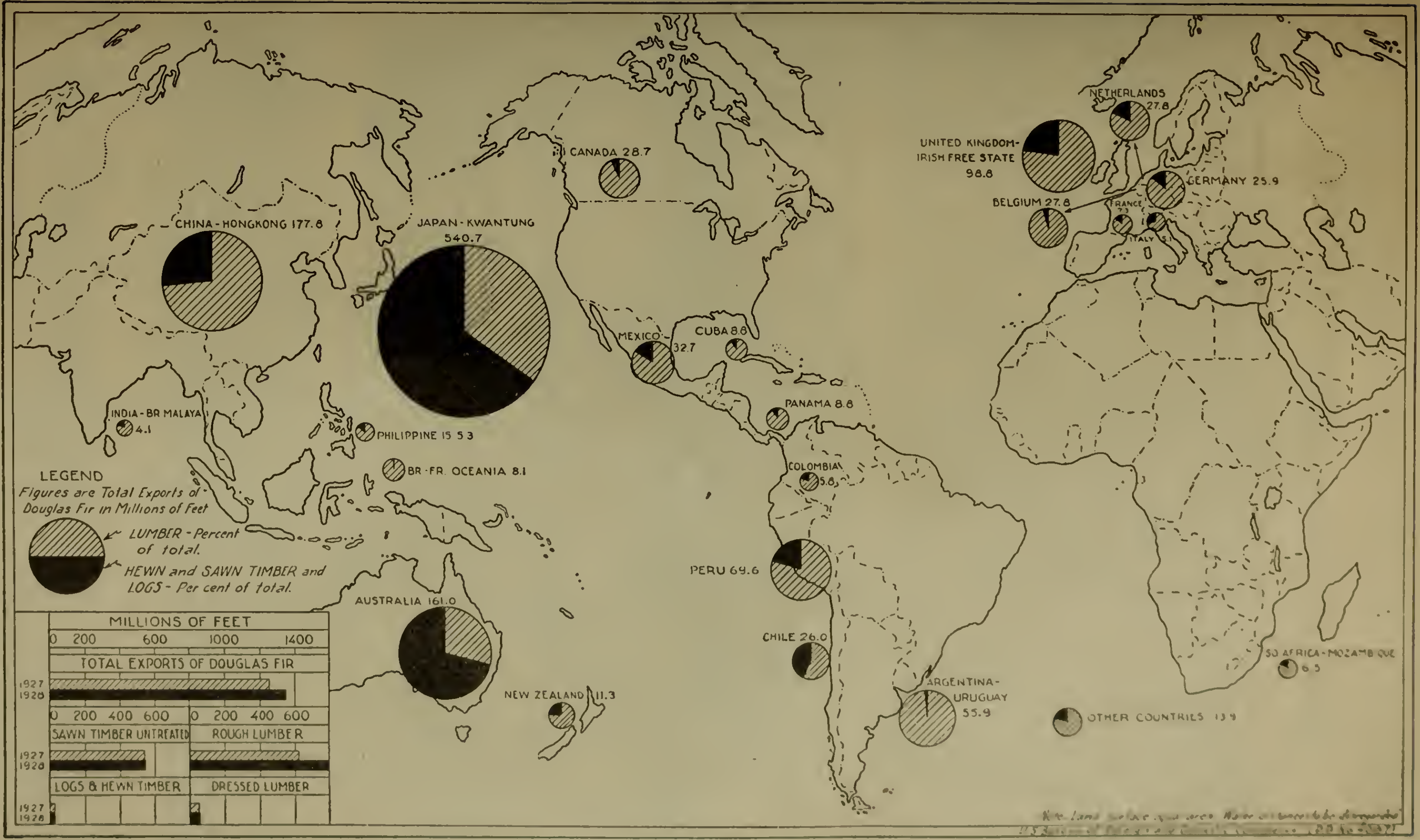

Figure 18.—FOREIGN MARKETS IMPORTING DOUGLAS FIR IN 1928. The scale of this map prevents separate designation of the smaller markets, which are covered in a statistical table in the Appendix, page 57

DOUGLAS FIR—A VERSATILE WOOD

A complete list of the uses of Douglas fir is nearly a complete list of wood uses, and it is liked as well abroad as it is at home. Europe's crumbling cathedrals have risen anew with the aid of this wood; many a refugee family there started life afresh within walls of Douglas fir. With it the Netherlands holds back the sea; Japan and China use it more than any other imported wood; Cuba buys it for concrete-form work. India uses it for railway sleepers. New Zealand took millions of feet of it for the South Sea Exposition buildings at Dunedin. Germany and Scandinavia choose it for ship decking and furniture. South African mines prefer it to European woods because of its strength properties and greater length. Spain fashions from it awnings and window blinds. Even countries with domestic supplies of softwood buy it in the sizes which they lack.

A versatile wood indeed.

A versatile wood, for there is scarcely a use for which a softwood is suitable to which Douglas fir can not be adapted. A report on Washington wood industries by the Portland, Oreg., office of the Forest Service says: "Probably no other wood is made into a greater variety of sawmill and planing-mill products." In the round as piling it goes into harbor work and dikes and into foundations to carry great weights. In large-dimension stock it builds bridges and trestles, and, like a modern Atlas, it timbers mines and underground workings; as railroad ties and ship parts it helps to move the world's commerce. Entire boats are often made of it. As framing it erects commercial and industrial buildings, and dwellings and schools and churches, and then as flooring and finish it completes the structure. In some markets its finds use as a furniture wood; in others, also as cooperage stock. Box manufacturers, veneer mills, agriculture-implement manufacturers, automobile-body builders—all and sundry draw on the fir forests of the Pacific slope for their raw material.

Versatility long recognized is shown by United States Forest Bulletin No. 88, issued in 1911:

> Douglas fir may, perhaps, be considered as the most important of American woods. Its rapid growth in the Pacific coast forests, its comparatively wide distribution, and the great variety of uses to which its wood can be put place it first. It is extensively used in the building trades; by the railroads in the form of ties, piling, and car and bridge material; and by many of the manufacturing industries of the country. As a structural timber it is not surpassed, and probably it is most widely used and known in this capacity.

Truly a versatile wood.

The market for Douglas fir is rapidly expanding; the prices, compared with those of foreign woods, offering decided advantages in conjunction with its well-known qualities.

The United States has over 100 kinds of commercial woods. Few other civilized countries have more than a dozen; those with more are largely undeveloped, and many of their commercial woods are badly scattered throughout their forests of usable and other trees. Versatility of Douglas fir will fill many "missing links" in all such countries; as an example, Douglas fir is a good furniture wood, although little is so used in the United States because of our finer woods such as oak and walnut.

Forms and Uses

Again quoting Forest Service Bulletin No. 88:

> Douglas fir is manufactured into almost every form known to the sawmill operator, and much round or hewed timber is used which never passes through a sawmill. A list of such forms and uses would represent many industries and would include piling and poles; mine timbers, railway ties, and bridge and trestle timbers; timbers for car construction; practically all kinds of lumber for houses; material for the furniture maker and boat builder; special products for cooperage, tanks, paving blocks, boxes, and pulpwood; fuel; and a long line of miscellaneous commodities, including wood for distillation.

Its main use, however, both at home and abroad, is as general construction material; 45 to 50 per cent of the output of the average Pacific coast sawmill enters into general construction, approximately 40 per cent into planing-mill, sash and door, and general millwork products, 5 to 7 per cent into car construction, and the remainder into a variety of items, the range of which is indicated below:

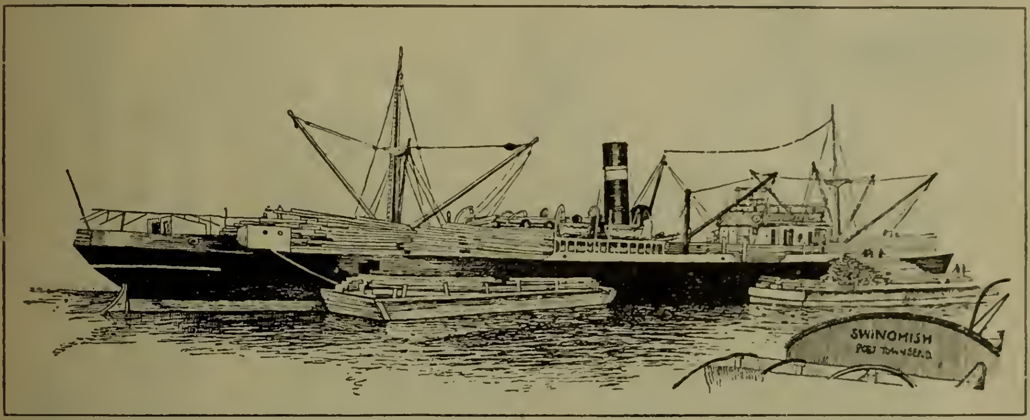

Figure 19.—LOADING SHIP. Ships from every corner of the world load Douglas fir lumber in Pacific Northwest ports

Principal Uses of Douglas Fir

BUILDING AND CONSTRUCTION:

Ordinary dwellings.—Framing; weather boards, roofers, sheathing, pickets, fences; interior finish and general millwork; flooring and flooring blocks; plywood and veneer; concrete-form work.

Heavy constructions.—Mill construction; bridge building; railroads (permanent way); port and harbor development; mine operations, oil derricks, and the like; highway and street construction.

INDUSTRIAL USE:

Pipe and tank stock; railway-car construction, boat and ship building; pumps and wood pipe; furniture and fixtures; boxes and crates; rollers; agricultural implements; woodenware; machine construction, machinery and apparatus; vehicles and vehicle parts; gates and fencing; refrigerators and kitchen cabinets; musical instruments; elevators; handles; saddlery; pulleys and conveyors; weighing apparatus; sporting and athletic goods; furniture.

Edge and Flat Grain

Douglas fir is sawed to produce considerable edge-grain stock. This is lumber with annual growth rings at 45° to 90° to the face, thus presenting to wear the maximum of the hard summer wood. It also, in boards or deals, yields uniformity in structure that increases strength values and stability as regards holding size and shape, or "stay put," as expressed in America. Edge-grain, often called vertical-grain, flooring and ship decking of Douglas fir are world articles of trade; and similar wearing uses, such as paving blocks,

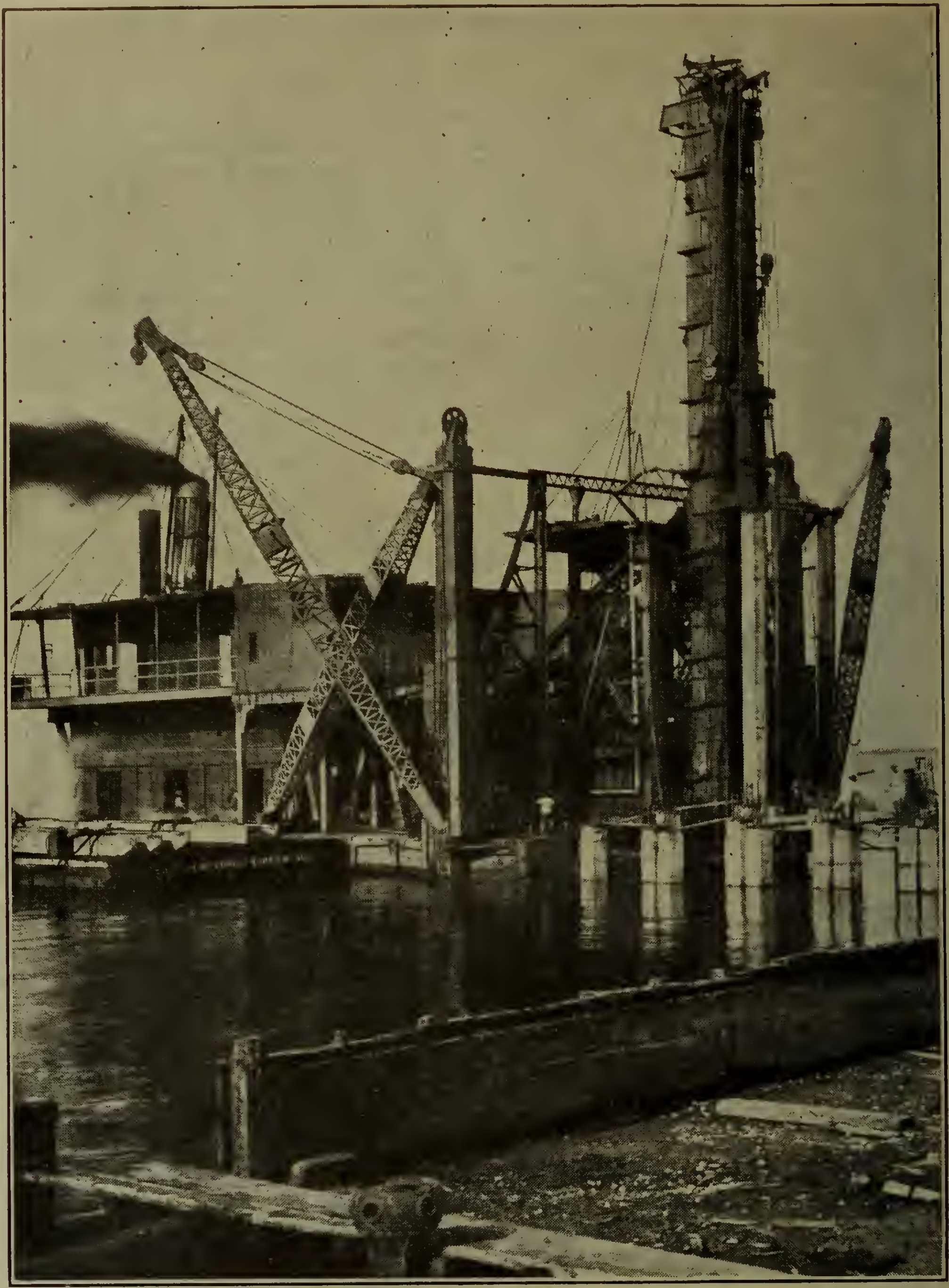

Figure 20.—MANILA PILE DRIVER CONSTRUCTED OF DOUGLAS FIR. Douglas fir was used for the hull, framing, spreads, and house of this pile driver

are satisfied with this wood. Among various exacting uses where edge grain stabilizes shape are sash and doors; obviously good sash and doors must stay true in size and shape.

Flat grain, sometimes called slash grain, has annual rings at less than 45° to the face. Since manipulation of logs and cants in sawing to get edge-grain cuts adds to cost and flat grain is entirely suitable for many purposes, a large proportion of Douglas fir lumber is flat grain. For floors without heavy wear, for stained or varnished interior finish because of its fine figure, for framing and sheathing, flat grain is fully satisfactory. In fact, only in North America is edge-grain lumber made, and every lumber consumer in the world getting softwoods from other countries is using flat-grain stock for every purpose.

Limitations

It must not be thought that Douglas fir will serve every known wood purpose. Its merchandisers do not claim that, nor that it combines all the good qualities found in different woods.

Preservative treatment is advisable in case of exposure to constant moisture, or alternate wetting and drying, but this is not necessary when the wood is always under water except where marine borers are found. Douglas fir has not the abrasive resistance of hardwoods, nor the resiliency of hickory or of ash, nor the smooth softness of white pine, but has greater suitability for a multitude of purposes because of its unusual combination of strength, durability, stiffness, nail-holding ability, and lack of tendency to warp, and because it is available in very large sizes as well as in small sizes.

While Douglas fir has different properties than have softer pines, spruces, and various other species used in different parts of the world, woodworkers have found that in case the methods used with other woods do not give the desired results it is a simple matter to make the necessary adjustments of woodworking equipment and practices to insure complete satisfaction in handling Douglas fir.

Woodworking plants in the United States which use large quantities of Douglas fir along with other species having totally different properties vary their machining and tooling practices when necessary according to the characteristics of the various species, and would not expect the methods approved for one kind of wood to produce the same results with another species.

On account of its density, Douglas fir has high nail-holding power. Dense woods, because of their density, split more in nailing than do softer woods, but in the United States a special type of non-splitting nail has been developed which provides freedom from splitting along with nail-holding ability.

Widespread Use in House Construction

In the United States Douglas fir is used extensively for house construction and general building and construction purposes, whether exposed to the weather or not. Its strength and comparative lightness fit it for joists, floor beams, rafters, and other timbers which must carry loads. Sawn flat grain, it is widely used for paneling and other interior finishing on account of its distinctive figuring. When sawn edge grain, its wear-resisting qualities, ease of working, beauty of grain, and ability to take a high polish make it a desirable flooring material. The comparative hardness of the wood fits it for this purpose, and it meets a large demand. Douglas fir edge-grain flooring is one of the best appearing and wearing wood floors; kiln-dried, flat-grain, it is hard wearing and has little shrinkage. The wood has gained an important place for interior finish. Clear lumber sawn flat grain shows pleasing figures, and the contrast between the spring and summer wood has been considered as attractive as the grain of the quarter-sawn oak. It stains well, and by staining the beauty of the grain may be more strongly brought out, and a number of costly woods can be successfully replaced. Douglas fir house-construction materials, besides being extremely popular in the United States, are in large and growing demand abroad.

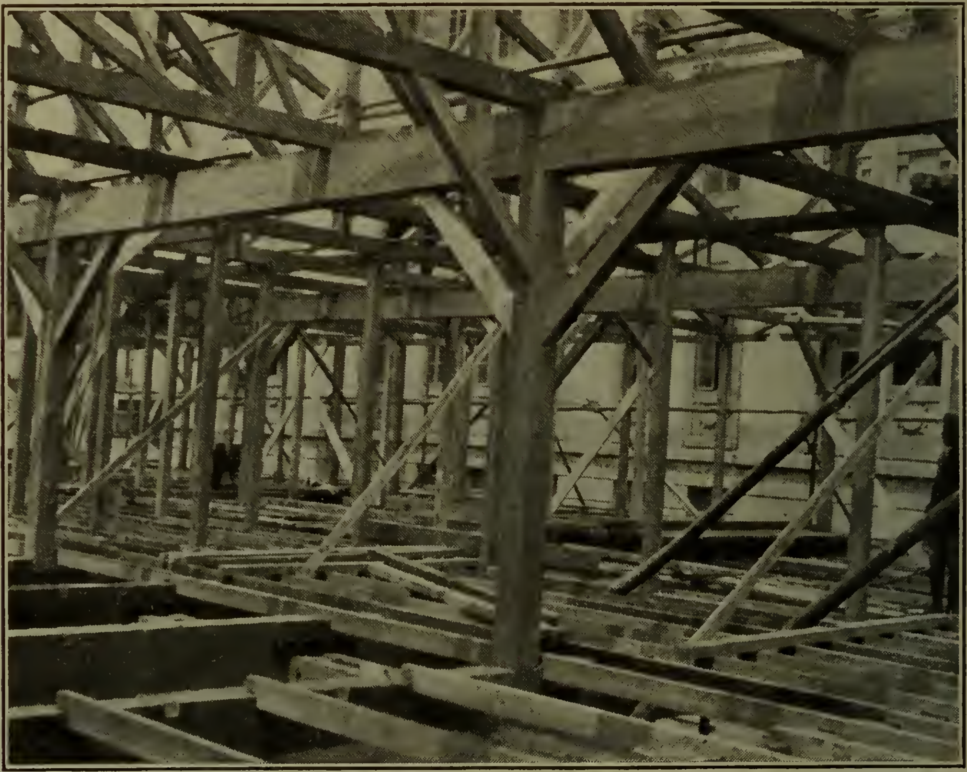

Figure 21.—DOUGLAS FIR IN TIMBER CONSTRUCTION IN JAPAN. Douglas fir is widely used in modern types of timber construction in Japan

Australia is one of the largest foreign buyers of Douglas fir and uses it for house building and construction generally. In each of 14 hotels recently built in the Cairns section of Queensland, Douglas fir was extensively employed, and it was also used in the new City Hall at Brisbane. Practical immunity to the powder post borer, which is so prevalent in Australia and causes extensive damage, leads many architects to specify "Oregon." The outside uses of Douglas fir are illustrated in Australia by veranda posts and pitching and stops for weatherboarding, not to mention heavy construction.

An Australian writer has said:

> Almost every Australian has to thank Douglas fir for keeping the roof over his head. Practically all our roof frames are constructed of Douglas fir,

> because our own hardwoods are too difficult to handle. But in many parts of Australia it is holding up the whole house. Practically the whole framework of wooden houses is constructed of Douglas fir. In a modern city building, like the Bank of New South Wales, Sydney, to be erected shortly, 250,000 super feet of Douglas fir will be required for the form work alone. But our dependence on Douglas fir is not confined to the building of homes and the rearing of city skyscrapers. To it also we must turn for our big public works which are to enable us to make the bush carry the vast population of the future. Without Douglas fir we can not effectively fling out our railways, run out big drainage and water works, or dam up the waters of our rivers for the irrigation of closer settlement areas.

Another Australian, Mr. James Nangle, author of Australian Building Practice, says:

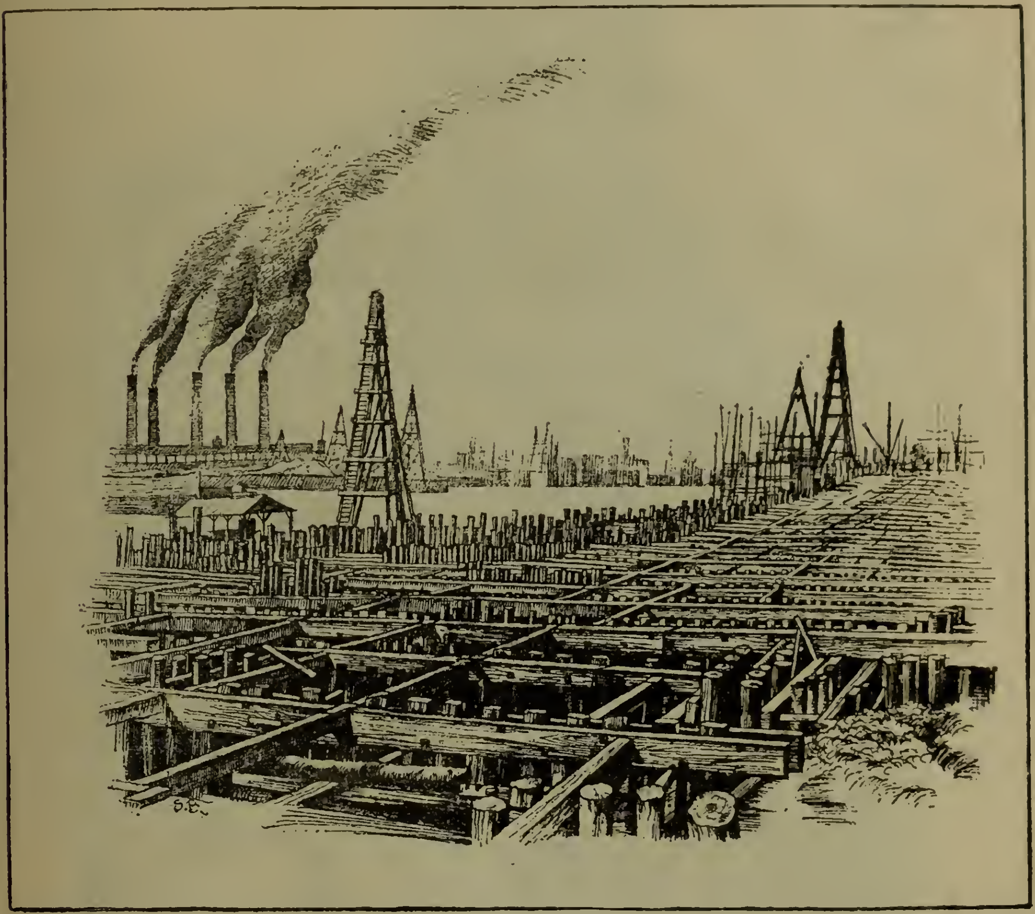

Figure 22.—DOCK CONSTRUCTION. Douglas fir is extensively used for piling and dock construction

> For use as scaffolding it is unequaled, being light and yet strong, and capable of being obtained in long lengths.

Scaffolding construction is subject to a special statute in New Zealand. Douglas fir is practically the only lumber of any value for that purpose, and some immense scaffolds have been built of Douglas fir scantlings.

One of the largest building contractors in New Zealand states:

> Long lengths, lightness, and strength. There is no trouble with it in the way of shakes; and since it is all straight stuff, does not warp, and is quickly worked, it makes admirable lumber for the big roof work, scaffoldings, and similar structures which are needed in this era of the skyscraper. Edge-grain flooring of Douglas fir is becoming popular in New Zealand, and this follows its

long use for heavy and house framing and finish. There is a growing demand for this lumber in connection with tile roofs.

South Africa buys Douglas fir for roof supports where long spans are necessary. There it is also the standard wood for flooring and in high-class construction, and in the Johannesburg section it is growing in popularity because of its ability to "stand up" in the dry atmosphere. Ceilings and paneling are finished to show the natural figure. Interior-finish use is increasing.

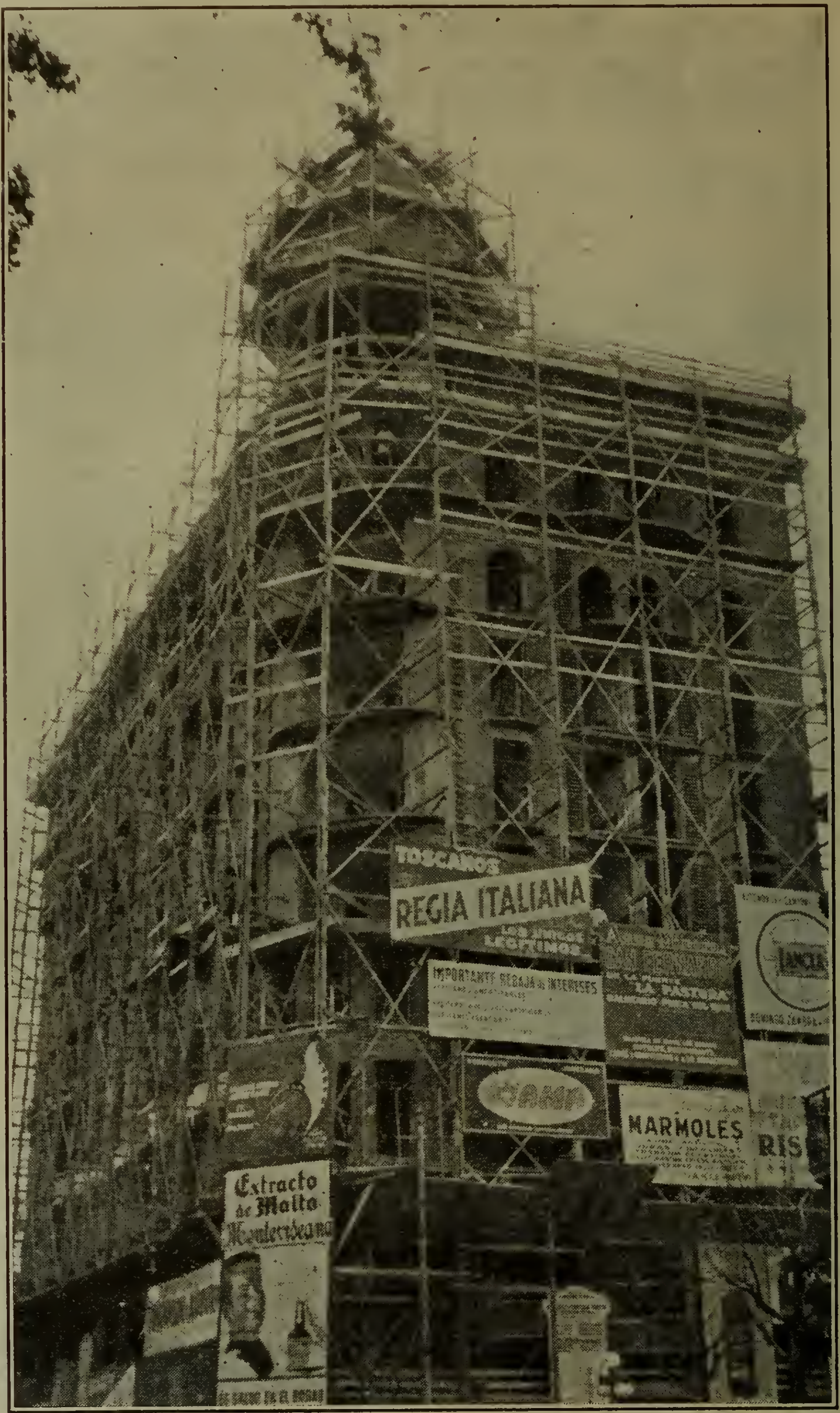
TOSCANOS
REGIA ITALIANA
IMPORTANTE REBAJA de INTERESES
LANCIA
MARMOLES
RIS
Extracto de Malta Montevideana

Figure 23.—DOUGLAS FIR SCAFFOLDING IN URUGUAY. Douglas fir is a favorite scaffolding material in South America and elsewhere

France imports strips and manufactures them into flooring, and strips are becoming popular for this use in many sections of Germany also. Germany likewise is showing interest in deals for window frames and sashes. The largest item imported by Belgium is strips for flooring, but that country also imports Douglas fir for general interior finish. Italy uses it for doors and window sash. English demand is for finish and high-class joinery and millwork—Clair College at Cambridge has a new building with Douglas fir finish—and Douglas fir parquet flooring is much used in that country.

Switzerland is only beginning to use kiln-dried Douglas fir lumber for flooring and short stock for remanufacture into parquetry flooring.

In Spain four-fifths of the total imports of this wood are for the manufacture of collapsible awnings or blinds (called persianas) for both doors and windows. There is also Spanish demand for stock for window sashes, stairs, and paneling, and for general carpentry.

North American style bungalows with Douglas fir framing, finish, and flooring have proved popular in suburban developments in Peru. Both flat and edge grain Douglas fir for flooring is finding outlet in Uruguay. Chile and Argentina are buying rough flooring strips. The picturesque houses of Japan use each year around 4,000,000 Douglas fir small or " baby " squares in house framing for " posts " (studs). Other sizes go for studs, as well as roof boards, eave rafters, beams, and frames of " shoji," the sliding paper partitions. Clear baby squares are wanted where they will show, this being due to the Japanese liking for a maximum of attractive exposed and unpainted wood surface in their homes. China employs " Oregon pine " for practically every construction purpose; the most common uses there are for door and window frames, floor joists, trusses, structural work, and flooring.

Ready-cut houses find an ideal wood in Douglas fir; it holds the factory-cut sizes and shapes, and its lightness and easy nailing make erection by even the home owner easy. And a whole house from sills to roof, from siding to finish and flooring, can be secured in one shipment from one plant.

Millions of Douglas Fir Doors

Douglas fir has captured nearly half the United States market for 20,000,000 stock doors a year because of its ability to retain its size and shape indefinitely; furthermore, Douglas fir doors can be supplied in clear grade, allowing staining or staining and varnishing, whereas stock softwood doors made in other countries are generally constructed of knotty lumber and must be painted to cover up the defects. The use of clear stock is especially important where the panels of the door are to be of Douglas fir plywood with its beautiful figure.

England has been definitely won over to the advantage of the Douglas fir stock door. Three-fourths of the 2,000,000 doors imported each year for the extensive housing schemes carried out there in recent years have been of Douglas fir.

Belgium, Netherlands, Germany, and Italy are taking Douglas fir doors. Countries like Spain, with high tariffs on manufactured goods, are planning to import cut stock and plywood. Latin-American architecture is being modified to take advantage of beautiful, but not costly, Douglas fir doors.

Douglas fir doors and cut-to-size stock have a strong hold in the Australian and New Zealand markets, besides which considerable quantities of 3-ply panels cut from this wood are taken to complete doors made from other woods.

Office and similar buildings in Japan are using American-style doors made locally from Douglas fir. In China, cheap native labor produces Douglas fir doors and many other millwork items locally.

Beauty Developed in Veneer and Plywood

The versatility of Douglas fir extends to veneering. In plywood, rotary-cut faces show attractive figure, the spring and summer woods form pleasing contrasts, and, by staining, the figure may be brought out more strongly. It is also used as a sliced veneer, in which form it gives a fine effect on account of its striking grain. It is made with waterproof glue and is not affected by any ordinary amount of moisture. Some very handsome panels of Douglas fir are installed in the Pan American Building in Washington, D. C. Besides beauty of figure, a distinctive feature of Douglas fir plywood is the large sizes in which it can be obtained.

Figure 24.—CUTTING SHORT LENGTHS IN EUROPEAN YARD. American lumber of long lengths is often cut into short lengths in European lumber yards. Short lengths may be purchased at a discount from Douglas fir exporters

In the United States the container industry, making boxes, baskets, crates, cases, drums, chests, barrels, hampers, wood dishes, and the like, is a large consumer of veneer; furniture tops, panels, backs, drawer fronts and bottoms, chair seats, trunks, store and office fixtures, musical instruments, refrigerators, and vehicle bodies are examples of the use of plywood. For all of these Douglas fir is well adapted. Automobile body builders are using 5-ply Douglas fir for running boards and dash and coil boards and in the building of automobile doors. Shipbuilders use it for the interior finish of ocean liners. Perhaps the largest users, however, are the door manufacturers, for panels—at home, and now in Australia and South Africa. England employs it, in addition, in the construction of omnibuses, railway cars, and benches in railway stations. And a recent London trade writer says:

> Douglas fir plywood is commanding an ever-expanding market, and in London, especially, the demand for boards of unusual width is increasing by leaps and bounds, it being preferred to almost any other kind for special purposes.

Germany, Italy, and Spain are importing Douglas fir logs to cut in their veneer plants.

Douglas Fir Standard for Railroad Use

Douglas fir lends itself in the United States and many other countries to a multitude of uses in railway construction and operation—ties, trestles, bridges, buildings, car material. Strength, lightness, workability, durability, and often size, lead to this large demand. For trestles and bridges, piling and large-dimension stock are called for; for buildings, any of the structural items; for car material, dimension stock for framing and sills and select common and clear lumber for siding, roofing, lining, decking, or flooring; and high-grade clear lumber and veneer and plywood find use for interior finish in passenger and dining cars.

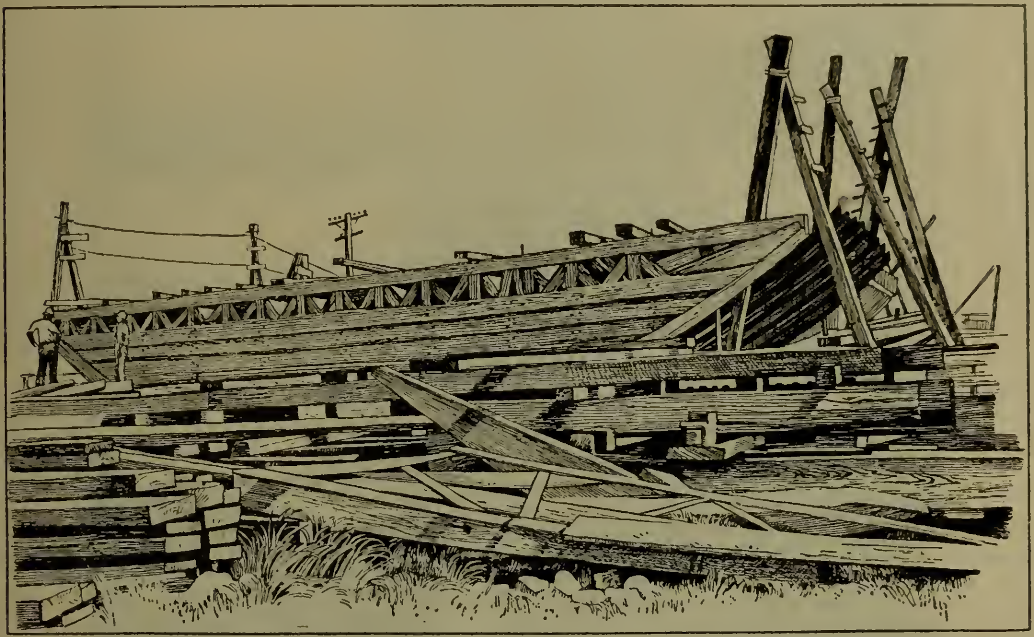

Figure 25.—BARGE CONSTRUCTION. This barge job of Douglas fir could have been sketched in almost any big harbor in the world

Railway ties of Douglas fir resist rail cutting moderately well, having high resistance to compression perpendicular to grain, but it is customary to use a steel tie-plate under the rail. A large proportion of the ties now used in the United States are treated with a preservative.

In Panama the creosoted Douglas fir ties are said to withstand the rains and the attacks of insect pests better than the native woods. Despite the handicaps of transshipment at Hong Kong or Singapore and high freight rates, direct cargoes go to India.

In car building, Argentina uses Douglas fir stringers. Japanese Government railway specifications call for clear creosoted fir for base frames, edge-grain creosoted posts, clear girders, edge-grain outside sash, clear flooring, and edge-grain ceiling; also, fir alternates with oak for platforms and joists. A cargo of Douglas fir received in England late in 1928 is reported as being used largely for freight-car sidings.

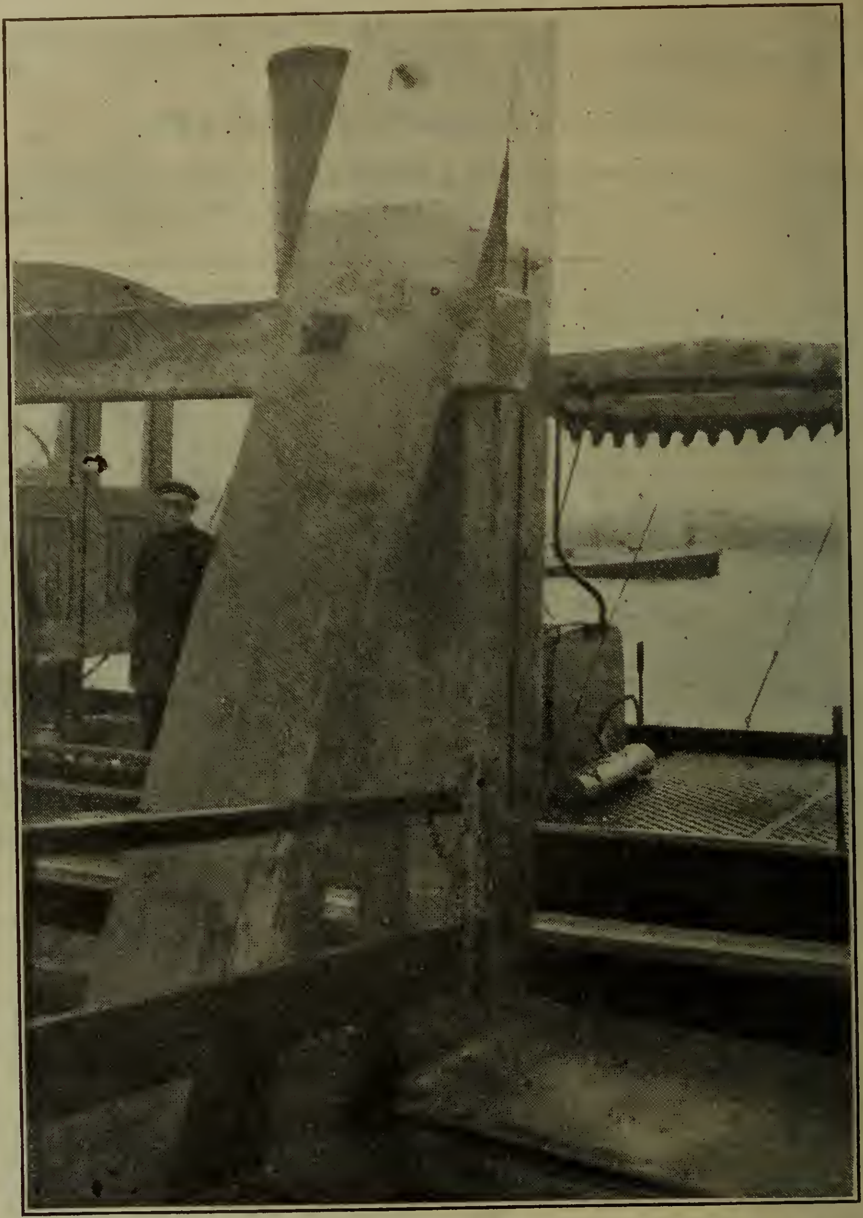

Figure 26.—DOUGLAS FIR IN ROTTERDAM HARBOR. Douglas fir is extensively used in the harbor works of Rotterdam, one of the world's best-equipped ports

Even the conservative British railways use Douglas fir for bridge timber, signal posts, piling, and cross and switch ties. Experiments that have been carried on for a series of years to test the lasting properties of Douglas fir sleepers on both the Great Eastern and the Great Western Railways have resulted in most favorable reports. The Great Western Railway laid 616 sleepers experimentally, and after 17 years only 23 had been removed and not one from mechanical wear; a remarkable record, inasmuch as approximately 15,000,000 tons of traffic annually pass over the ties. Other ties laid eight years ago are favorably reported on by the engineers of the various companies.

Germany is now using Douglas fir in railroad-car construction, for beams and stringers and other parts.

A report from Canada says that on account of its lightness, the use of Douglas fir in the construction of railway cars effects an economy in operating expenses on account of the reduction in the dead weight drawn by locomotives.

World-wide Shipbuilding Uses

Douglas fir has long been the most important timber for boats and ships on the Pacific coast of the United States. It is suitable for both outside and inside work, and ships which are built almost wholly of this wood have been long in service in the carrying trade to many parts of the world. Nor is Douglas fir confined to Pacific coast dockyards, but finds its way to shipbuilding ports on the Atlantic coast. It finds a place in all sizes of vessels, from the rowboat to the ocean liner. It is particularly suited for decking, planking, keels, yards, ribs, and finish. A considerable quantity is made into rough-hewed knees for large ships. These knees are obtained by so splitting stumps as to leave pieces of the stump with each root, and they are then hewed to the required shape and size. Ribs of this wood give much rigidity and strength. It is claimed that Douglas fir is not inclined to soften when used in boats. Few woods meet the requirements for masts as well as Douglas fir, and the demand is great and widespread. The regular taper, durability, strength, and resilience give it its chief value.

In the restoration of the historic American wooden frigate *Constitution* ("Old Ironsides"), built in the year 1797, which was decreed by the American Congress in 1925, Douglas fir timber played an important rôle. Over 100,000 board feet of pressure-creosoted Douglas fir were used for the longitudinal framing, the deck beams, and timbers below the berth deck. Upon this permanent framework the less durable portions, such as the decks, bulkheads, and ceilings, left untreated for finishing purposes, can easily be renewed when necessary.

Edge-grain Douglas fir decking is in demand all over the world because of the long lengths in which it is obtainable.

The newer British battleships, as well as many of the ocean liners under the British flag, such as the *Berengaria*, have decks of this wood. British Admiralty plans for its future use have influenced several English shipbuilding companies to adopt it also. The ships of the Canadian Mercantile Marine and the Canadian Pacific Railways have Douglas fir decking. It is also being used in English yachts, from small to very large tonnage. Even Sweden, one of the world's most important exporters of pine and spruce, uses Douglas fir almost exclusively for ship decking.

Germany takes Douglas fir for masts as well as for decks. The yacht *Meteor*, belonging to the former Kaiser, has splendid masts of unusual height made of Douglas fir. Finland buys Douglas fir for decking, as does France also, and even Denmark. Japan uses it for lighters and barges as well as general ship construction.

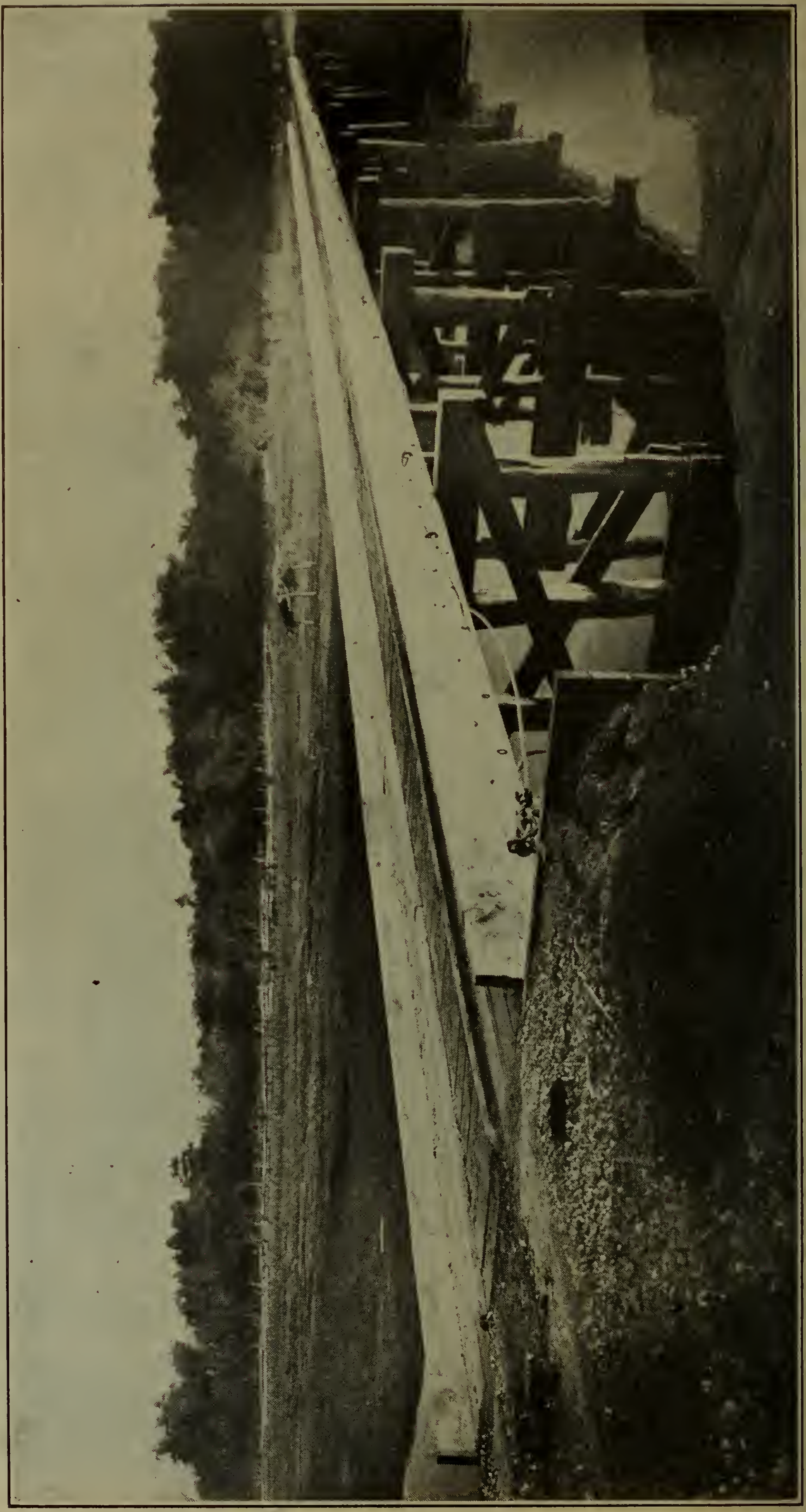

Figure 27.—DOUGLAS FIR USED IN BRIDGE CONSTRUCTION IN EAST ASIA. At times of high water, the two halves of the superstructure float around and up against the banks. Treated Douglas fir resists decay and was used for this purpose

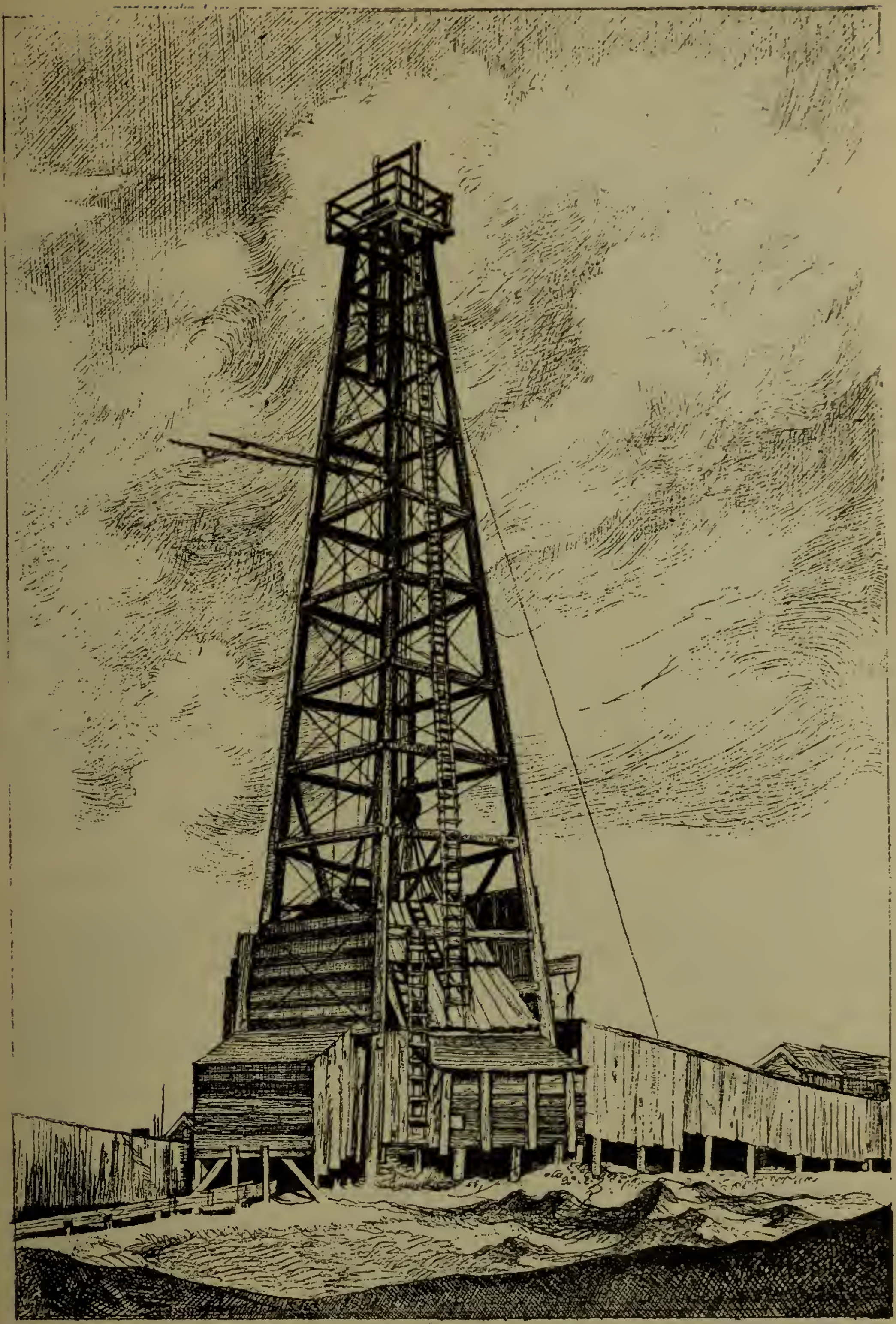

Figure 28.—OIL DERRICK CONSTRUCTION. Douglas fir timbers are in great demand for oil derricks wherever oil is found

The New Zealand Navy christened its first target early in 1927. Built of Douglas fir at a cost of approximately $50,000, the target was the first in that part of the world.

For less exacting marine uses the wood serves—dredges and dredge anchors and scows in Canada and United States, as well as river boats in China and lighters in South American harbors.

Dry docks in Rotterdam, built with Douglas fir, made use of pieces up to 90 feet long by 2 by 2 feet.

Douglas Fir Preferred for Mine Timbers

Wholly apart from its size, strength, lightness, and durability, Douglas fir possesses a quality that peculiarly fits it for mines and other underground workings, namely, the audible warning which it gives before breaking under strain, thus enabling workers to reach safety.

Douglas fir is much used as a mine timber, in both square and round forms, in the United States. It is frequently preferred to all other available species because of its durability and strength and because of the desirable sizes in which it may be obtained. It also goes largely into temporary work, such as lagging, sills, posts, and caps. Under American practice, when intended for permanent mine work, both square and round peeled timbers are treated—generally by impregnating with creosote or zinc chloride.

Upon the occasion of a general upward tariff revision Australia made special provision for the free admission of " Oregon " in specified sizes, if for mine use. Mines in the vicinity of Port Pirie, Australia, import 20,000,000 feet of " Oregon " each year.

The mines of South Africa buy it for shaft timbering, headgear construction, supports for tanks, battery foundations, and framework for heavy mill machinery; the requirements as to length and thickness make Douglas fir practically indispensable for these purposes.

In Mexico both the mines and the smelters are large users of Douglas fir where tensile strength is important. In 1927 one company ordered 25 carloads to be shipped to Chihuahua to build a coke trestle. Despite a developing native lumber industry in the south of Chile, the nitrate mines in northern Chile continue to take Douglas fir for timbering and other heavy-service duty in the mines and nitrate oficinas. Because of sizes, lengths, and strength, Douglas fir mine timbers are the standard in Peru.

A 1928 dispatch from Sydney, Australia, advised:

> We will require 4,000,000 feet of Douglas fir for the scaffolding and false work on the great bridge which we are now throwing across, in one huge span, from the southern to the northern side of Sydney Harbor. This bridge will carry electric trains, motor and horse-drawn vehicles, and pedestrians across a stretch of water which has for years been an obstacle to traffic and progress in the premier city of the Commonwealth.

Oil derricks in California and other oil-producing States, Peru, Colombia, Trinidad, and Venezuela are of Douglas fir; other countries use it for derricks of various kinds and for well-drilling machinery.

Lock gates are made of it. The new locks of the Welland Canal in Canada, between Lake Ontario and Lake Erie, were built in 1924

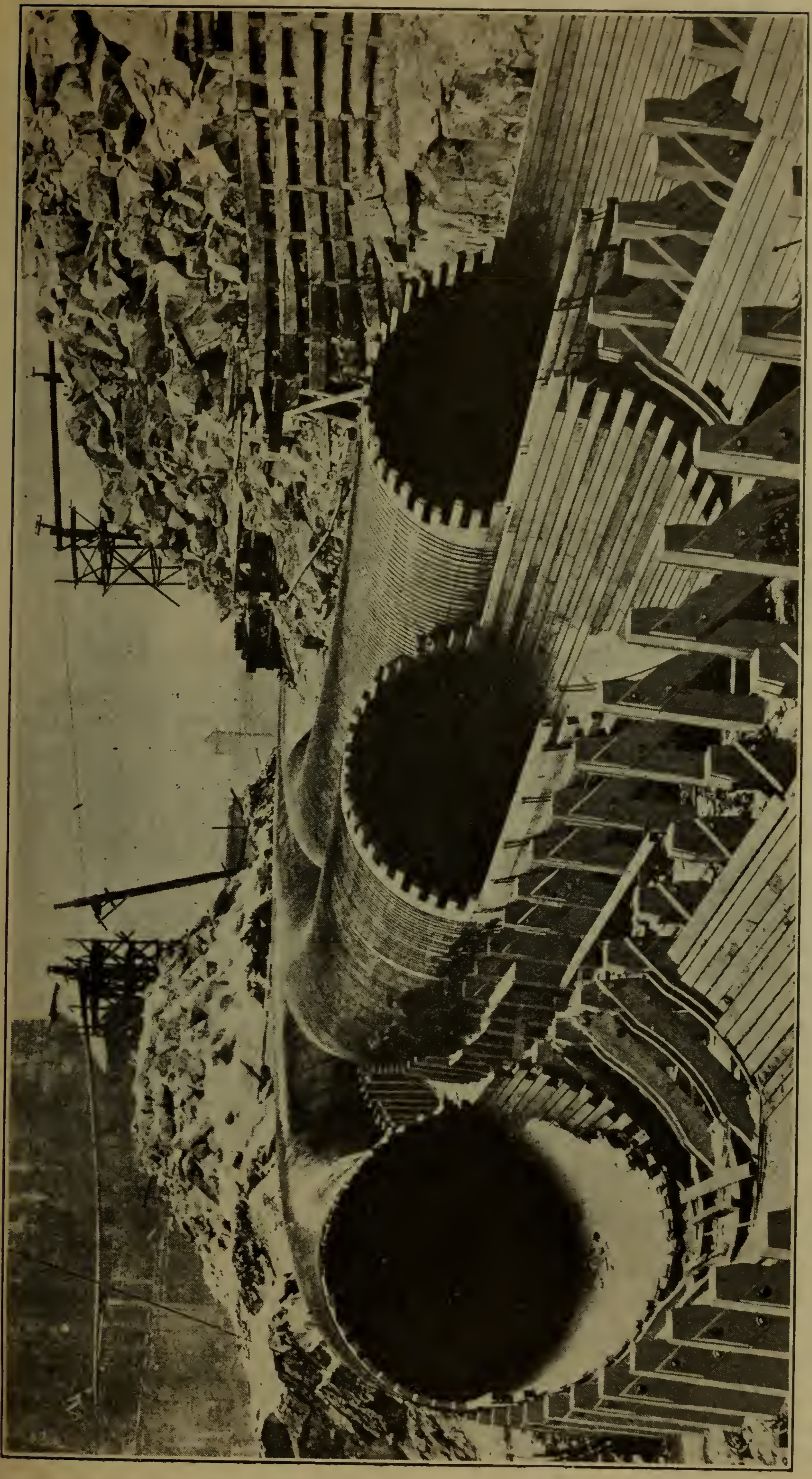

Figure 29.—DOUGLAS FIR WATER PIPE. Hundreds of miles of Douglas fir pipe lines are carrying water over arid regions and mountains in North and South America

of this wood; nearly 1,000,000 board feet of huge timbers 48 by 48 inches by 50 feet were secured from the State of Washington.

In the Canal Zone the uses of Douglas fir large-dimension stock are most varied. During construction of the canal the United States Government used for a year an average of 1,000,000 feet a day. In 1927 it was utilized for skids and cribbing to move an 875-ton concrete building (the old terminal building at Cristobal); it is being employed for heavy foundation work in the warehouse at Mount Hope, now under construction, which will consume an estimated 500,000 feet; the new Diesel-engine power plant at Miraflores will consume a like amount. Other uses include untreated dock shores, railroad crossings, lock fenders, and an overhead railroad for a coal dock.

A movable bridge at Manila illustrates a very interesting use of the wood. The piles are of native timber, but the superstructure is of Douglas fir. It is built in sections strung together and attached to the banks by cables. In times of unusually high floods the water lifts the superstructure off the supporting piles and the current washes each half of the bridge to the bank of the river. When the flood subsides, the sections are lifted back onto the piles.

In the harbor at Rotterdam and in the famous dikes of Holland Douglas fir piles and other timber have been used and found satisfactory to the exacting Dutch engineer.

Serves for Concrete-Form Work—Floor and Paving Blocks

The ability of Douglas fir to stand renailing makes it popular for concrete-form work; it can be set up over and over again before becoming unserviceable, and much is used in the United States. Cuba purchases Douglas fir for this purpose, for in that island the use of concrete is universal—in the humblest home, the finest palace, the most unpretentious or the most substantial business building; in the public parks and (as culvert and curb) along the highways; in aqueduct work; practically everywhere. Concrete's increasing use in Uruguay, together with the large amount of new building going on, has stimulated the consumption of Douglas fir in that market. Argentina employs Douglas fir for scaffold decking and supports as well as for form work, and the Philippine Islands like it particularly for standard concrete forms that are to be reused a number of times.

The wear obtainable and the ability of the wood to absorb sufficient creosote recommend edge-grain Douglas fir for floor and paving blocks. Creosoted blocks for street paving are noiseless, economical in upkeep, and long wearing even under heavy traffic. These blocks are both manufactured in American mills and cut in foreign mills from imported stock. England uses imported ready-made blocks and those manufactured in local factories from kiln-dried edge-grain lumber as well. They are much favored in England for schools, assembly halls, offices, and private residences, where a wood of higher class than European pine is desired but still at a moderate cost. Japan buys stock for remanufacture into treated street-paving blocks.

Ideal for Water Pipes, Tanks, Cooperage

A wood for the construction of water conduits or for ordinary tanks must possess the properties of strength and impermeability or resistance to saturation by water. Hundreds of miles of Douglas fir stave pipe lines in the United States attest the suitability of Douglas fir for this purpose. The largest wood pipe line in the world, 16 feet in diameter, of creosoted Douglas fir, was built at Capco, Calif., for the California-Oregon Power Co. Three 13-foot Douglas fir pipe lines at Berlin, N. H., take the entire flow of the Androscoggin River for a paper mill, and there are Douglas fir pipe lines in South America and Australia.

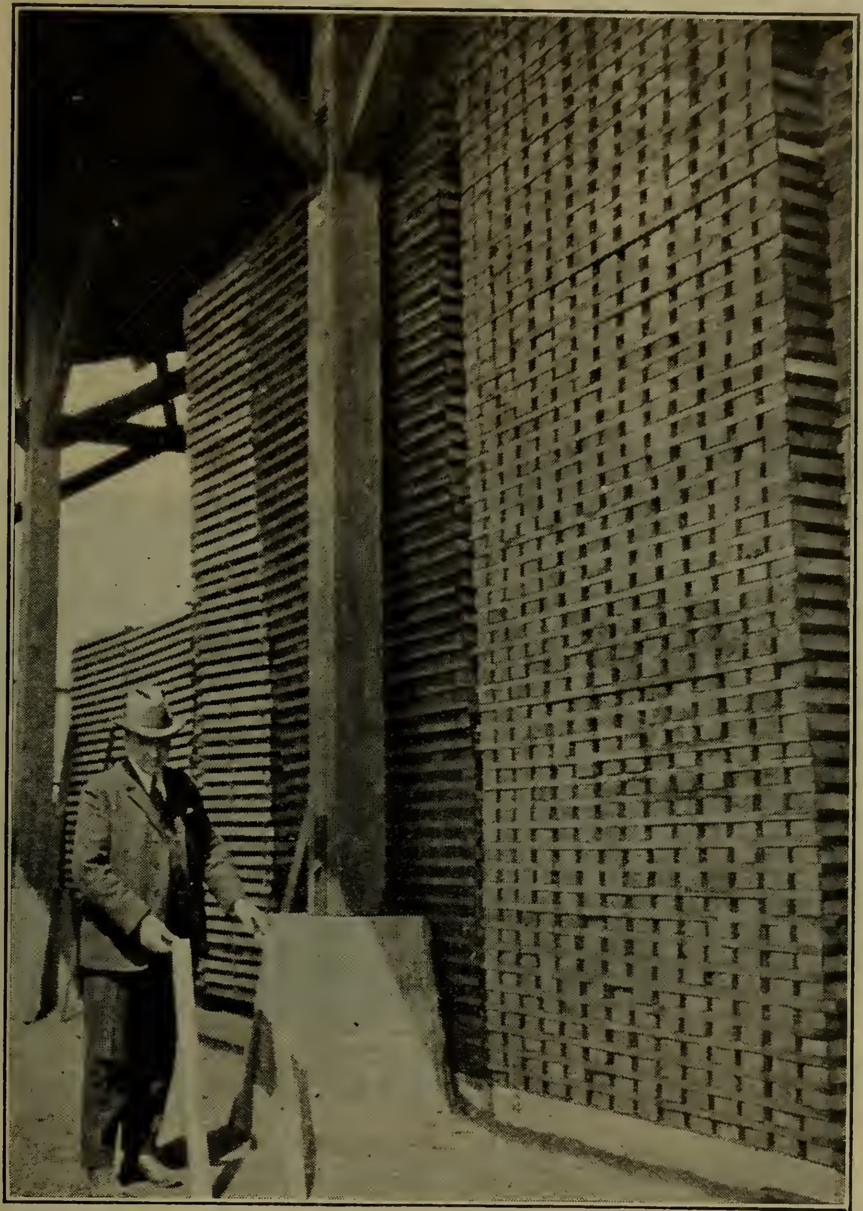

Figure 30.—DOUGLAS FIR SMALL DIMENSION IN EUROPE. Most Douglas fir mills can supply cut-to-size stock for foreign industrial needs

Pipe staves are made from flat-grain lumber, with the wood as nearly of uniform growth as may be had. They are made in such shape as to give the finished conduit a cylindrical form, and its different parts are so closely fitted as to make it waterproof. When the pipe is 24 inches or less in diameter it is constructed from staves of special pattern, with grooved edges. Such pipes are built up at factory and are wound from end to end with m which the exterior is covered with an asphalt-a preservative purposes. The thickness of the sta the wire reenforcement varies according to the p the pipe is to be used.

Conduits larger than 24 inches are set togethe they are to be used. Such pipes are always co being so placed as to break the joints. In large are usually 6 inches wide, with beveled edges, an form to the circumference of the pipe. When t set in place, the pipe is drawn tight with steel ba the joints are closed. Conduits thus constructed f in the water and hydroelectric systems of many

Figure 31.—DOUGLAS FIR USED IN RAILROAD CAR GERMANY. No wood in Europe surpasses Douglas fir fo on account of its strength properties and the large dim available

cities, and are widely used for manufacturin works, hydraulic mining, dredge work, oil pipe

In locations where wood would be susceptible to dec
should be creosoted. Proper creosote treatment will r
objectionable taste to water after the first run.

Both tight and slack cooperage are made from Do
tight packages can be used as containers for all liqui
that contain alcohol, and serve for the shipping of oi
pickles, and meat. In some cases the barrels are coat
paraffin. Coopers like the wood because it is strong
nearly impervious to water.

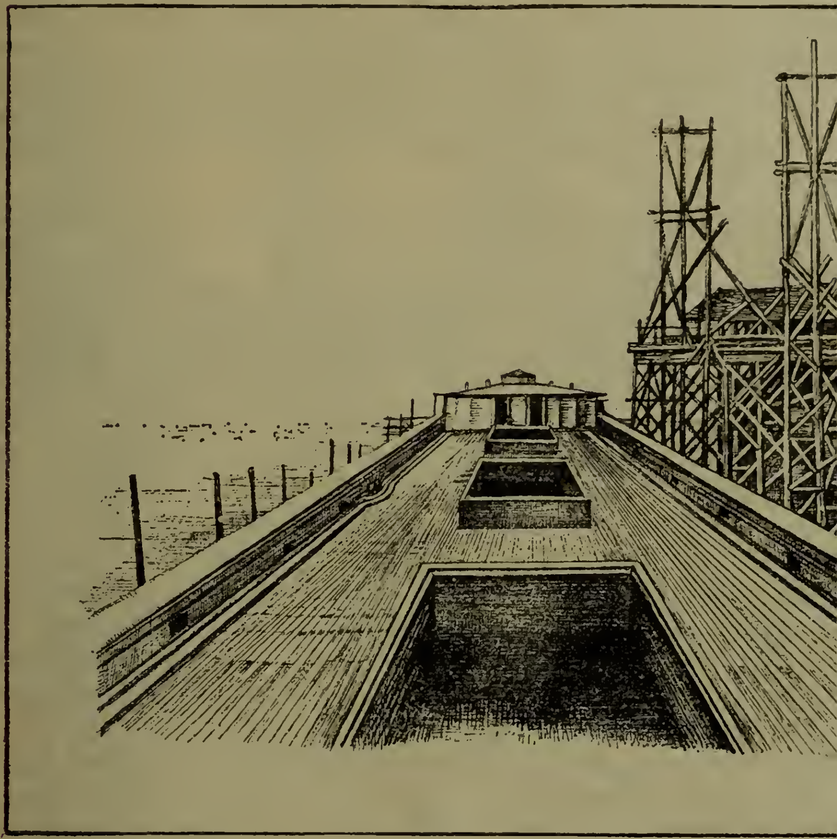

Figure 32.—BARGE DECK. Satisfactory resistance to wear, ability
loads, and straight-grain make Douglas fir an excellent shipbuil

A 1928 report from England advises that for the try
receptacles for chemicals Douglas fir is now widely
the best wood on the market.

The American farm silo, an air-tight structure aver
15 feet in diameter by 30 feet high with doors dow

resilience, and especially its resistance to water absorption add to its suitability. The wood is sufficiently hard to penetrate most soils readily, and it acts well under the hammer, though occasionally banding may be necessary to prevent brooming or splitting in driving where there is a hard subsoil. In driving creosoted piles better results are obtained with a steam than with a drop hammer.

Untreated Douglas fir piling is fairly durable, although its life will vary, of course, with the location; an alkaline soil, for example, might cut its period of service. For locations infected with marine borers, preservative treatment is advised and is desirable for best service. The final report issued in 1927 by the San Francisco Bay Marine Piling Committee, composed of piling and timber producers and railroad, municipal port, and Federal engineers, which had for 13 years kept careful service records of marine structures in San Francisco Bay, confirmed and recommended creosoted Douglas fir for such use.

The port of Rotterdam is one of the most important consumers of Douglas fir in the Netherlands; since the water is fresh or only brackish, there is no need for using teredo-proof timber for piling and dock lining, and uncreosoted Douglas fir finds a large application there for many purposes. In Ireland great quantities of this wood are being used in port work; besides the work lately completed at Belfast, where the harbor commisisoners made extensive use of the wood for piling, landing stages at both Dublin and Cork are of Douglas fir. In England the Admiralty uses it and several of the Thames wharves and those at Southend are of Douglas fir. The wharf at the Government rifle range at Purfleet, constructed in 1891 of creosoted Douglas fir, is reported in excellent condition. The conditions of alternate wet and dry, due to tides as at Belfast and on Thameside, are the most trying to which timber can be subjected. Uncreosoted Douglas fir piling at Swanscombe (on Thames) has now served 22 years.

Japan imports Douglas fir piles for foundations, bridges, and harbor work. The use of Douglas fir piling for foundations is particularly important because of the large amount of construction in Japan on marshy or filled-in land.

The Canal Zone still takes large quantities of this wood in the form of piling, for use on the wharves, for lock fenders, and numberless other needs. The Philippine Islands, too, are steady customers for Douglas fir piling for derricks, pile drivers, fender floats, and piers.

The popularity of Douglas fir for masts and spars has already been alluded to. It is also a favorite for flagstaffs—the 214-foot flagstaff in Kew Gardens, London, is of Douglas fir—and it is being used for wireless masts, telegraph and telephone poles, tent poles, and in similar ways.

Many More Uses

Numerous other uses might be recited for this versatile wood. There is almost no purpose for which wood is or can be put for which Douglas fir is not utilized.

In England and Germany Douglas fir is now being largely employed in the manufacture of furniture, it being found of special value for table tops and kitchen cabinets, while for the more conspicuous parts of dressers and other household requirements its pronounced and beautiful graining have made it a universal favorite.

Canada has reported all the major uses and such minor uses as bins, ladders (exterior and step), wagon reaches, boxes, and poles, and similar parts of agricultural implements. Interesting English uses are for washing machines, fire-ladder stock, staves, and cloth beams or rollers in textile mills.

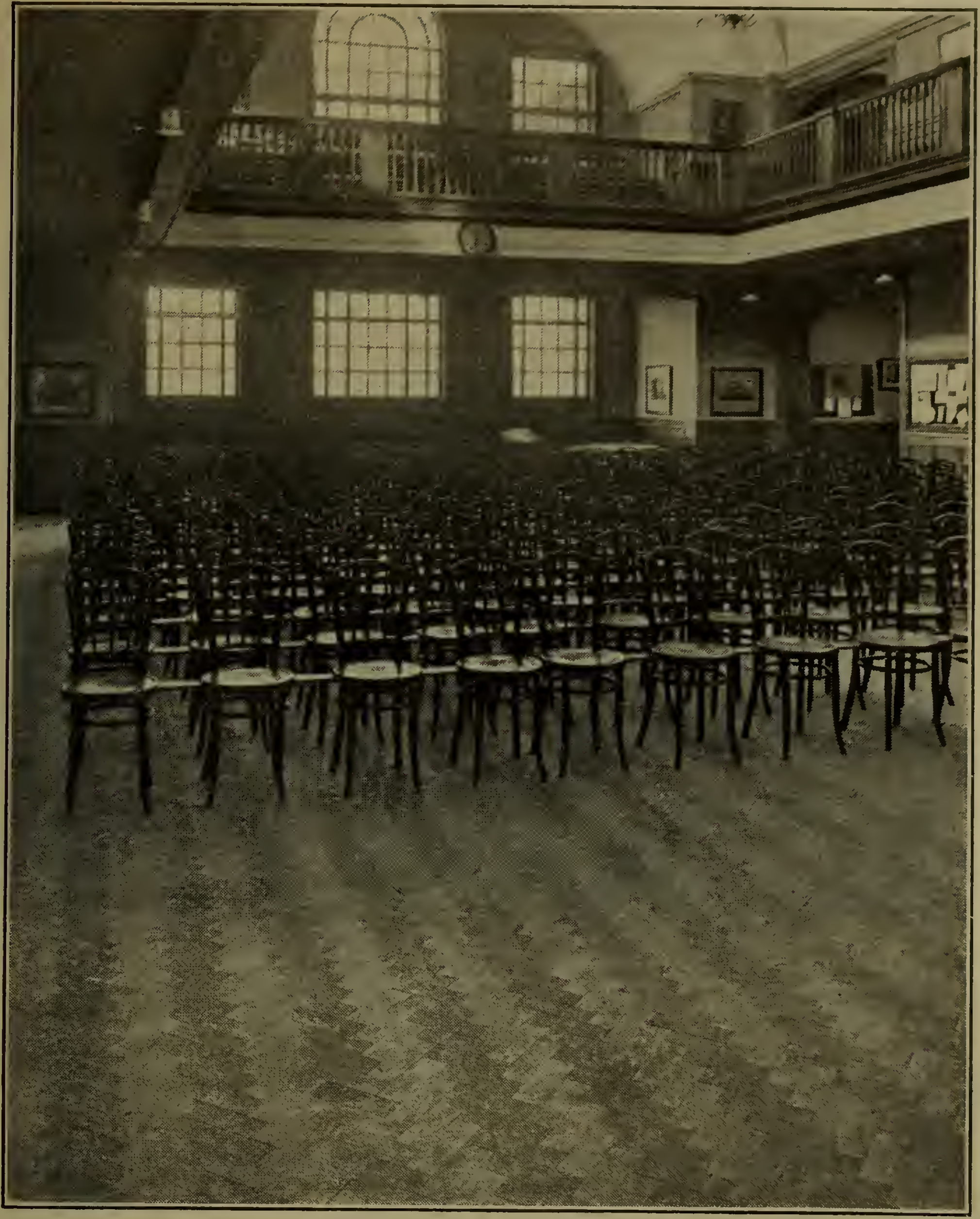

Figure 33.—DOUGLAS FIR FLOORING BLOCKS IN ENGLAND. Douglas fir flooring blocks are extensively used in England instead of the more expensive hardwoods

Chemical Preservative Treatment of Douglas Fir

The object of preservative treatment is to provide an envelope of treated wood, toxic to fungi, and toxic or repellant to marine borers and insect destroyers. Seasoning is one of the important preliminary factors in treatment, in order to reduce to a minimum checking after treatment and consequent exposure of untreated wood. Douglas fir is not readily penetrable by preservatives, and an incision machine has been designed to open up numerous close-spaced, small cuts on all faces of stock, to the depth penetration is desired in each case. The principal reason for difficulty of penetration is that, owing to the small amount of sapwood on Douglas fir, treatment must be largely in heartwood, and heartwood in all species is resistant to treatment. On the other hand, with a large amount of sapwood goes rapid growth, and with rapid growth usually coarser grain, lighter weight, and larger knots, so that the grade and strength of treated Douglas fir, frequently more than offsets the longer time required for treatment.

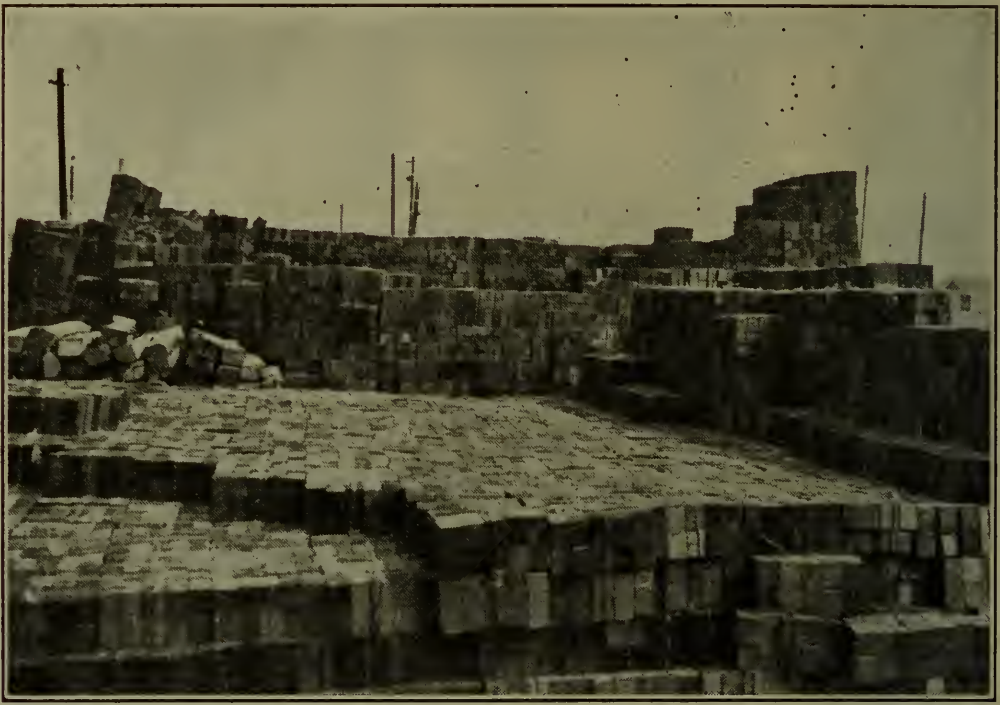

Figure 34.—DOUGLAS FIR FLOORING BLOCKS FOR SCHOOL IN JAPAN. Douglas fir is universally used in Japan. Douglas fir flooring blocks are chosen on account of the durability of this material when subject to wear

The report to the American Railway Engineering Association, 1927, on The Value of Treated Timbers in Wooden Bridges and Trestles, stated:

> Creosoted timber has not been in general use in railway bridges a sufficient length of time to determine accurately its average service life. Some structures have lasted more than 40 years and still retain a large percentage of the original timber. Others have been renewed after a service life of about 20 years. Of the latter class the short life has usually been due to inperfect handling of the treatment of the timber itself or by failing to protect the cut surfaces when framing the timbers. The art of creosoting timbers and of handling creosoted timbers has improved, so that it is safe to predict an average useful life of 30 or more years for creosoted timbers in bridge structures.

Creosote (dead oil or coal tar) and zinc chloride are the most commonly used preservative chemicals. Technical specifications for the chemicals and the process may be obtained from the American Wood Preservers Association, Chicago.

The permanence of preserved material depends on keeping intact the envelope of treated material. If it were not for abrasion and checking, the penetration could be very slight and the material still be given complete preservation from decay and borers: Treated material should be handled carefully, and any framing or cutting should be done before treatment takes place, if possible. If any boring or cutting after treatment is unavoidable, the fresh wood should be painted with several coats of hot creosote.

Efforts to force creosote into Douglas fir too rapidly, under high temperatures and pressures, have in some instances resulted in reduction in strength, but the methods now in practice, while requiring somewhat longer time, can give treatment without material loss of strength, and the method of perforating the surfaces developed by the Pacific coast creosoting companies insures uniform penetration to any necessary depth.

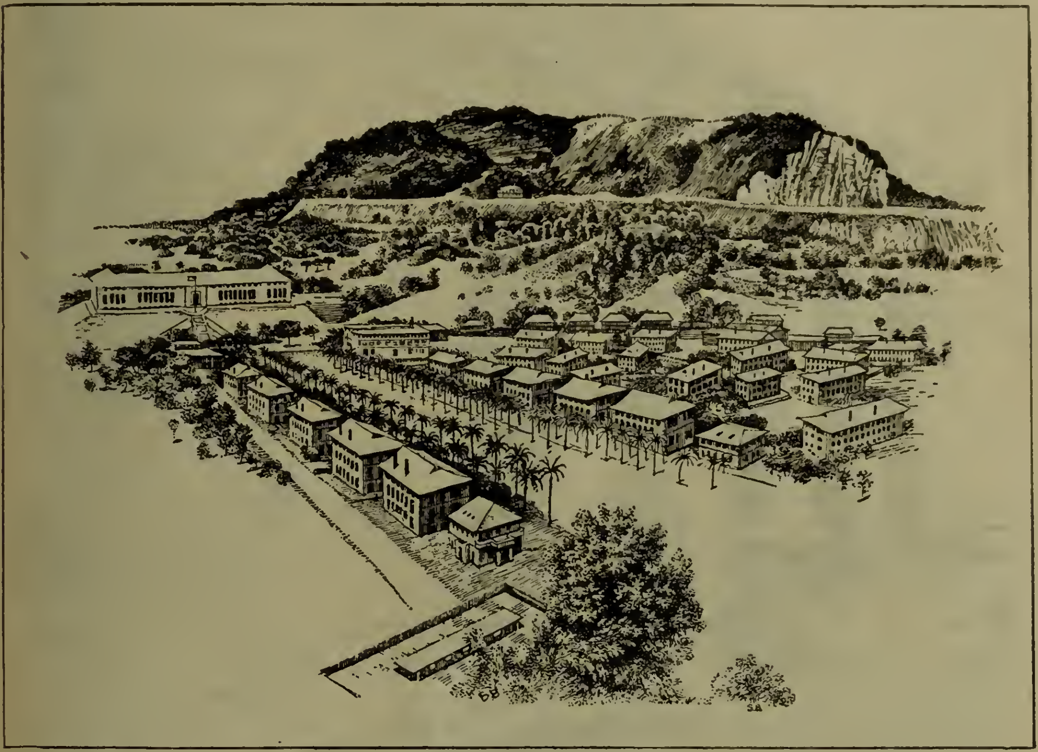

Figure 35.—A TROPICAL CITY. Douglas fir was exclusively used in the building of this Central American city

Lower working stresses are recommended for untreated timber exposed to the weather than for use in dry, interior locations in order to allow for loss in strength due to some decay during the useful life. This allowance does not have to be made for treated timber, and any loss of strength in treatment would be less than that allowed for decay, so that treated timber can be used at working stresses as high as, or even higher than, those for untreated timber.

Short-Length Lumber

Most foreign markets are already fully conversant with the utilization of short lengths and the economy entailed in their use. In what has gone before, some emphasis has been laid on the long lengths procurable in Douglas fir stock. As has also been said, mass production is the keynote of the Douglas fir industry, to achieve which mills must work to standardized sizes. In cutting these standard sizes there is inevitably produced a large quantity of "remnants" anywhere from 2 to 8 feet in length but in quality equal to the rest of the board from which they were cut. At present these short lengths do not appear on the regular export lists; hence foreign buyers are not always aware that they can be procured at an appreciable saving in price. These short lengths have other advantages as well; inasmuch as they are bundled at the mill, they can be used to "chink in" a shipment of standard-length material, utilizing waste cargo space and at the same time protecting the higher-priced long lumber from damage through shifting. Short lengths can be bought at a discount.

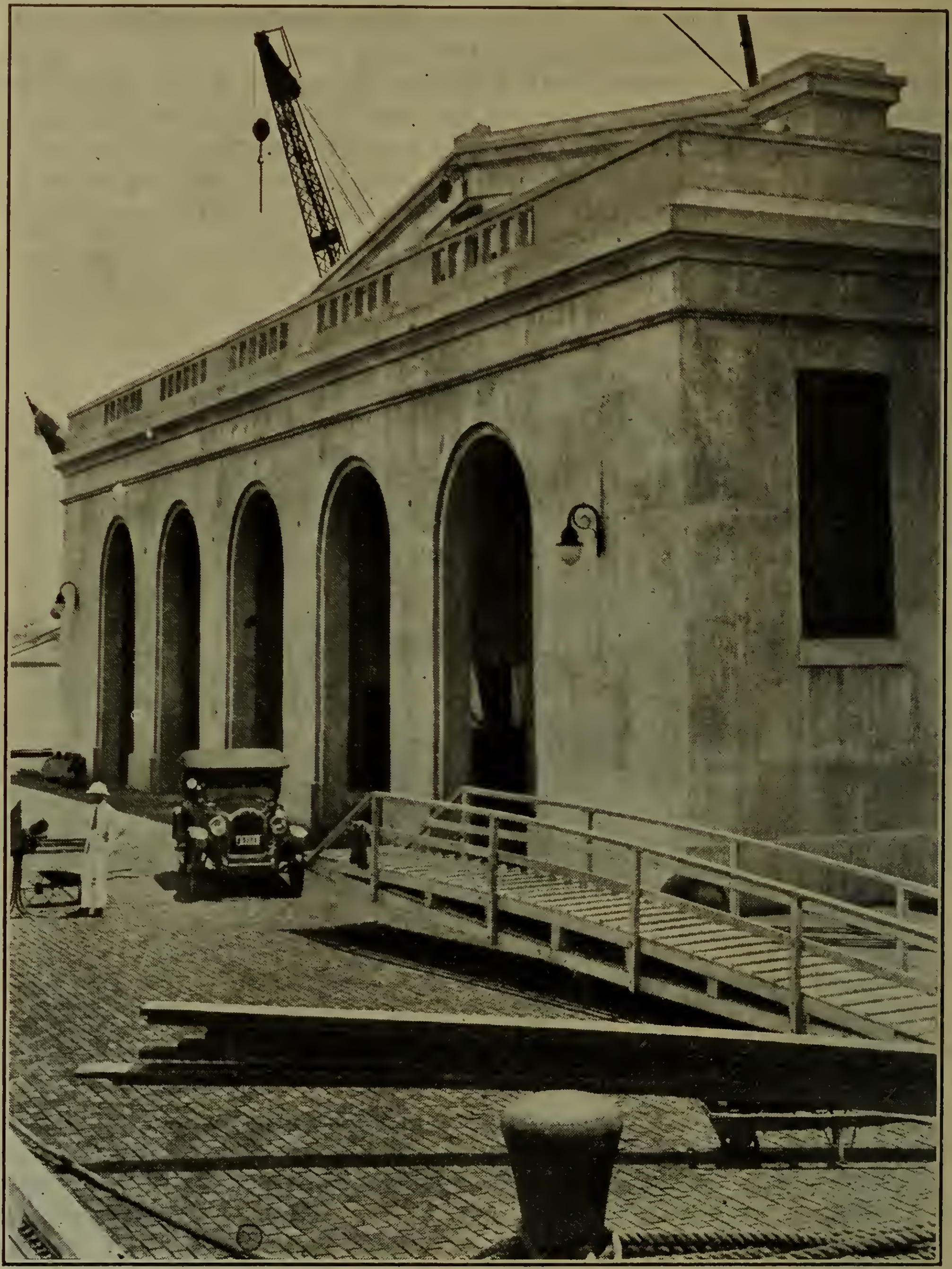

Figure 36.—DOUGLAS FIR ON MANILA DOCK. Even in far away Philippines, Douglas fir is used in dock construction. Note creosoted Douglas fir paving blocks

Since the short lengths are obtainable in all the various mill products (framing, siding, flooring, ceiling, rough and dressed lumber), they are available for every use to which Douglas fir lumber can be put, save only those where length is a requisite; and even length requirements can be gotten around in flooring, siding, and the like if end-matched lumber is purchased. In a bulletin (No. 393) on industrial outlets for short-length softwood lumber, the United States Forest Service named the following specific uses:

> Refrigerators, ice-cream cabinets, automobile export boxes, sectional and ready-cut buildings, caskets and shipping boxes therefor, garage-door panels, incubators and brooders, tanks and vats, automobile running boards and floor boards, screen doors, stepladders, advertising-sign panels, washing machines, beehives, agricultural implements, commercial fixtures (show cases, bins, and shelving), toys, cable reels, box and crate manufacture generally, railway-car industry, millwork, woodenware, shade and map rollers, patterns and flasks, grain doors, fences, piano boxes, car racks (in refrigerator cars to hold goods off the floor and assure a better circulation of air), scale-beam boxes, and factory trucks.

The bulletin of the National Committee on Wood Utilization, The Marketing of Short-Length Lumber, shows that in the typical American small house, 20 per cent of the framing lumber as finally used is under 8 feet long, and goes into detail on all house parts as to lengths. Since construction in the United States takes 60 per cent of the lumber production, this is important to mills in regard to short-length disposal. While frame houses are not prevalent in other countries, yet the same considerations apply to such wood framing and parts as are used.

Cut-to-Size Stock

For square or small-cut stock, Douglas fir is ideal among softwoods. It holds shape and size when properly cut and seasoned. Door stock has been mentioned; it is probably the oldest use. Broom and mop handle stock, squares or other sizes for furniture parts, sets of pieces for washboards, and many other kinds of stock can be secured from the mills. Since much high-grade lumber is available from cutting and trimming, the Douglas fir mill is a better place to secure good-grade small-dimension stock for any use than a stock of common lumber.

Cut stock is rough-size stock, such as a 1¼ inches square to turn to 1 inch. It can be obtained free of defects; in fact it is the same as the rough cuts the factory abroad takes from deals or timbers, without the defects, and on cut-to-size stock the buyer does not pay freight on the waste nor have it to dispose of. He gets only pieces sized and seasoned ready for his lathe or other machines. He saves on freight, on storage space, on figuring his cuttings from " merchantable " or " common "; he gets semimanufactured material.

Not all Douglas fir mills are equipped to handle cut-to-size stock, or small dimension, as it is called in America, but many of them offer such as the following examples:

Door cuttings (stiles, rails, muntins).
Sash cuttings.
Piano parts.
Vehicle parts.
Railroad-car stock (including larger sizes).
Washboard parts.
Furniture and house-fixtures parts.
Turning squares.

APPENDIXES

I. Detailed List of United States Uses of Douglas Fir

Agricultural implements, derricks, frames, hoppers, sieves, seed boxes, chutes, drawers, fans, rakes, tedders, threshing machines, etc.
Airplanes, struts.
Automobiles, truck bodies.
Balusters.
Barges.
Barrels, tight and slack, oil, vinegar, asphalt, lime, cement, beef, fish, bottles.
Baseboards, interior finish.
Baskets, hop.
Battens.
Beams, ship, house, etc.
Bedroom tables, enamel, stain or oak finish.
Blinds.
Blocks, paving, flooring.
Boards, general construction.
Boards, ironing.
Boats, general construction—framing, planking, decking, house.
Boats, fishing—entire.
Bookcases, stain or oak finish.
Bottoms, wagons.
Boxes, apple, peach, seed, wagon.
Brackets.
Breakfast tables, stain or enamel finish.
Buffets, stain or oak finish.
Built-up lumber.
Bureaus, enamel, stain or oak finish.
Cabinets, kitchen, medicine—stain or enamel finish.
Cabins, boats, ships, etc.
Car construction, siding, framing, flooring, roofing, finish, etc.
Cases, book—stain or oak finish.
Casing, interior finish.
Caskets.
Ceiling.
Chairs, kitchen—stretchers.
Chairs, overstuffed—entire framework except exposed parts.
Chiffoniers, enamel, stain or oak finish.
Chutes, agricultural implements.
Closets, linen.
Clothes racks.
Columns.
Cooperage, tight and slack—staves, heading.
Cores, panels.
Cornice work.
Cots.
Couches, frames.
Crates.
Cribbing, corn.
Cross arms.
Curbing, well.
Davenports, overstuffed—entire frame except exposed parts.
Decking, boat, ship, car.
Decoy ducks.
Derrick poles.
Dining room furniture, stain or oak finish.
Dining tables, stain or oak finish.
Desks, stain or oak finish.
Doors, solid and built-up—stock, special; house, garage, and French doors, silo doors.
Dowels.
Drawers, furniture, fixtures.
Dressers, enamel, stain or oak finish.
Drums, coffee.
Dumb-waiters.
Dressing tables, enamel, stain or oak finish.
Elevators.
Exterior finish.
Fanning mills.
Fans, agricultural implements.
Fencing posts, nails.
Finish, interior and exterior—house, car, ship, boat, etc.
Fixtures, showcases, counters, church pews—entire or facings and backs.
Flasks, foundry.
Flooring, house, car, etc.
Frames, agricultural implements, cars, couches, doors, windows, mirrors, sieves, springs, tents, boats, etc.
Fruit packages.
Furniture, bedroom, kitchen, built-in, lodge, theater.
Grills.
Gutters.
Handles, broom, brush, mop, flag.
Harvesters, frames and uprights.
Heads, cooperage—tight and slack.
Hop baskets.
Hoppers, agricultural implements.
House construction, general.
Interior finish.
Ironing boards.
Joists.

Keels.
Kitchen cabinets, enamel and oak finish.
Kitchen chairs, stained or unfinished—stretchers.
Kitchen tables, stain or enamel finish.
Kits, pickle, fish.
Ladders, sides.
Lath.
Launches, entire or parts.
Library tables, stain or oak finish.
Lining, car.
Living-room furniture, stain or oak finish.
Lodge furniture.
Machine construction.
Mantels.
Masts.
Molding.
Motor vehicles.
Newel posts.
Overstuffed furniture, frames, legs, stretchers.
Pack saddles, cross pieces.
Pails, fish.
Panels, solid and built-up.
Partition.
Pews.
Pickets.
Piling.
Pins, tent.
Planking, ships, boats, roads, etc.
Playground equipment.
Plywood, cores, veneer, etc.
Poles, telephone, transmission, hop, etc.
Poles, rug, tent, curtain.
Poles, wagon.
Porch work.
Posts, sawed, round and split.
Pulleys.
Pulp, paper.
Racks, clothes.
Rafters.
Railing, porch, stair, etc.
Rails, fence.
Rakes.
Refrigerators.
Roofing, car, silo, tank, etc.
Rough boxes.
Rug poles.
Running boards, car.
Saddles, tree.
Sash.
Scantling.
Screens.
Scrollwork.
Seed boxes.
Shelving.
Shipbuilding, general.
Shiplap.
Shutters.
Siding, house, car, ship, etc.
Sills, house, car, ship.
Silos.
Spars, ship.
Spring frames.
Squares, turning.
Stakes, tent.
Stands, wash—stain, oak, or enamel finish.
Staves, cooperage—tight and slack.
Staves, pipe, silo, tank.
Stems, ship.
Stepping.
Stringers, bridge.
Struts, airplane.
Studding.
Swings, lawn.
Tables, bedroom, breakfast, dining, dressing, kitchen, library.
Tanks.
Tedders.
Tent frames.
Theater furniture.
Ties, railroad, bridge, switch.
Timber, bridge, trestle, mine, wharf, etc.
Timbers, ship, boat.
Toggles, tent.
Tops, table.
Towers, water.
Trunks.
Tubing, well.
Tubs, ice cream.
Turning squares.
Vats.
Vehicles, horse-drawn.
Veneer.
Wagons, bottom, box, pole.
Wainscoting.
Wardrobes.
Washing machines.
Washstands, enamel, stain, or oak finish.
Well tubing.
Windmills.
Woodenware.
Wood pipe.

II. Brereton Log Scale

West coast exporters of fir logs now generally employ the Brereton log scale in measuring shipments.

Board feet.—In the Brereton system of scaling, to obtain the contents of a log in board feet (the ordinary American unit), multiply the square of the average middle diameter in inches by 0.7854 and the product by the length in feet, then divide by 12.

The average middle diameter is found by ascertaining the average diameter of each end of the log (measured inside the bark) in inches rounded off to the nearest whole number; these two averages are added together and the sum divided by 2.

In determining the average diameter of the ends it is customary to take two measurements, the longest diameter and one at right angles to it through the geometric center (not pith or growth center) of the section, and the average of these is assumed to be the average diameter of that end. When the butt is flared (swelled) the scaler reduces the diameter measurements to what it would have been had the butt held to a regular form.

Cubic feet.—To obtain cubic contents of round logs the Brereton string measure is used. The circumference of the log, in inches, is first divided by 4 to get the quarter girth; the resulting figure is squared, then multiplied by the length in feet, and the product divided by 113. This formula is identical with the British customs system of measurement.

III. Board Feet Equivalents of Foreign Lumber Units for Douglas Fir

Foreign units of volume	Equivalent in American board feet		
	Sawed lumber	Hewn timber	Round logs
Cubic meter (35.3 cubic feet)	424	[1] 353	[1] 283
Petrograd standard (165 cubic feet)	1,980	[1] 1,650	[1] 1,320
Rippo (Japanese)	12	----------	----------
Koku (Japanese)	120	----------	----------
Shakujime (Japanese)	144	----------	----------

Foreign unit of weight (for sawn timber)	Green [2]	Air dry [3]	Kiln dry [4]
Metric ton (2,204.6 pounds)	697	778	840

[1] Approximate.
[2] Basis: Green, 38 pounds per cubic foot.
[3] Basis: Air dry, 34 pounds per cubic foot.
[4] Basis: Kiln dry, 31.5 pounds per cubic foot.

IV. United States Exports of Douglas Fir, 1928

[In M feet]

Country of destination	Logs and hewn timber	Sawn timber, untreated	Lumber, rough	Lumber, dressed	Total
Japan	20,272	326,905	174,565	13,915	535,657
China	6,543	38,414	102,624	20,102	167,683
Australia	1,928	112,499	45,206	1,466	161,099
United Kingdom	94	21,122	72,621	3,630	97,467
Peru	1,243	12,795	54,512	1,061	69,611
Argentina	207	895	44,888	1,410	47,400
Mexico	165	5,027	23,630	3,880	32,702
Canada	330	1,637	24,594	2,229	28,790
Netherlands	275	4,787	22,590	210	27,862
Belgium	310	1,092	26,374	60	27,836
Chile	911	10,269	14,455	372	26,007
Germany	1,104	2,470	22,179	175	25,928
New Zealand	----------	2,745	5,616	3,033	11,394
Hong Kong	----------	816	9,283	115	10,214
Cuba	10	819	6,794	1,270	8,893
Uruguay	----------	54	8,493	18	8,565
Panama	----------	857	2,167	5,795	8,819
France	260	808	6,307	10	7,385
British South Africa	----------	1,138	4,519	323	5,980
Colombia	----------	1,114	2,800	1,886	5,800
Philippine Islands	16	712	4,625	----------	5,353
Italy	788	651	3,690	----------	5,129
Kwantung	----------	4,540	37	532	5,109
French Oceania	1	77	4,330	339	4,747
British India	15	726	2,827	----------	3,568
British Oceania	----------	1	2,606	762	3,369

IV. *United States Exports of Douglas fir, 1928*—Continued

[In M feet]

Country of destination	Logs and hewn timber	Sawn timber, untreated	Lumber, rough	Lumber, dressed	Total
Venezuela		84	2, 103	168	2, 355
Portuguese Africa		10	1, 776	99	1, 885
Irish Free State		253	1, 096	8	1, 357
Denmark		254	720	30	1, 004
Spain	11		961		972
Surinam		800	23	75	898
Haiti			409	475	884
Bolivia		42	615	73	730
Asiatic countries, n. e. s		691			691
British Malaya		80	472		552
Ecuador		48	463	33	544
British West Indies			325	203	528
Brazil		20	480	1	501
British West Africa		371	99	6	476
Salvador		114	306	24	444
Algeria and Tunisia		108	208		316
Sweden			125	157	282
Netherland West Indies			72	206	278
Newfoundland and Labrador		26	188	58	272
Guatemala		36	163	58	257
Canary Islands			200	43	243
French West Indies			115	115	230
Gibraltar		225			225
Norway			5	208	213
Virgin Islands			81	9	90
Ceylon		60			60
Nicaragua		32			32
Dominican Republic				24	24
Azores and Madeira Islands			18		18
Egypt			11	6	17
Belgian Congo			14		14
Soviet Russia in Asia			12		12
Siam			5		5
Morocco			4		4
Java and Madoera			3		3
Total	34, 483	556, 224	703, 404	64, 672	1, 358, 783

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Lumber Division, Department of Commerce:

Lumber conversion tables: (1) Petrograd standards to board feet; (2) cubic meters to board feet; (3) feet and inches to meters, and inches to millimeters; (4) cubic feet to cubic meters and vice versa; and (5) lumber price conversion table, indicating price per M board feet compared with equivalent price per Petrograd standard, per cubic foot, and per cubic meter.

Table: Strength values for various American and European species of wood.

The National Committee on Wood Utilization, Department of Commerce:

Marketing of Short-Length Lumber. Covers the use of short-length lumber for construction purposes.

End-Matched Softwood Lumber and Its Uses. Explains the practical application and use of end-matched stock for economy in building and construction.

Sawdust and Wood Flour. Treats the manufacture and principal uses of sawdust and wood flour.

Grade Marking of Lumber, for the Consumers' Protection. Handles the subject of grade marking from the consumers' viewpoint.

Seasoning, Handling, and Care of Lumber (consumers' edition). First of a series of four monographs on the proper seasoning, handling, and care of lumber. Written from the consumer's point of view.

Seasoning, Handling, and Care of Lumber (fabricators' edition). The second of a series of four monographs on the proper seasoning, handling, and care of lumber. Written from the distributor's point of view.

Seasoning, Handling, and Care of Lumber (fabricators' edition). The third of a series of four monographs on the proper seasoning, handling, and care of lumber. Written from the fabricator's point of view.

Report on Seasoning, Handling, and Care of Lumber (manufacturers' edition). A report based on questionnaires sent to sawmill units and plants in the United States covering their methods of seasoning and handling lumber. Types of dry kilns, drying methods, and plant operations, as indicated by the compilation of data from these questionnaires form the basis for the bulletin.

You Can Make It. First of a series of 10 bulletins. Gives 100 suggestions, accompanied by drawings, covering uses for second-hand boxes and crates and odd pieces of lumber.

Handbook on Wood Construction. A complete handbook on the uses for the principal American woods in building and construction, also a detailed description of the best construction methods in all branches of wood construction. 700 pages; 500 illustrations.

The Sap Stains of Wood and Their Prevention. A treatise on practical methods of preventing sap stain.

Small Dimension Stock, Its Seasoning, Handling, and Manufacture. Gives information regarding best practices and discusses standardization.

Tests of Scandinavian Gang Saws on the Pacific Coast.

Special prices are quoted for the purchase of the above publications in quanity lots.

Munger, Thornton T. Timber Growing and Logging Practice in the Douglas Fir Region. United States Department of Agriculture Bulletin No. 1493, 1927.

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Numerous publications on different uses of Douglas fir published by the West Coast Lumberman's Association, Seattle, Wash., can be secured from exporters.

VI. Abbreviations

AD	Air-dried.
Bd. ft	Board foot (an area of 1 square foot by 1 inch thick).
BM	Board (foot) measure.
Com	Common (grade).
D&M	Dressed and matched; that is, surfaced with tongued-and-grooved edges.
EG	Edge grain; either vertical grain or within 45° from vertical.
FG	Flat grain; nearly parallel with surface, or other than edge grain.

Ft. or ′	Foot or feet.
Flitch	A flat piece of lumber 3 inches and thicker.
In. or ″	Inch or inches.
KD	Kiln-dried.
M	Thousand.
Merch	Merchantable (grade).
Rough	Undressed lumber; that is, not surfaced
SF	Superficial feet (same as BM.).
SM	Surface measure.
S1E	Surfaced one edge.
S1S	Surfaced one side.
S2S	Surfaced two sides.
S2E	Surfaced two edges.
S1S1E	Surfaced one side and one edge.
S1S2E	Surfaced one side and two edges.
S2S1E	Surfaced two sides and one edge.
S4S	Surfaced four sides.
S4SCS	Surfaced four sides with 1/16-inch calking seam on each face edge 1½ inches deep.
T&G	Tongued and grooved.
No. 2 clr (& btr)	No. 2 clear (and better), grade.
4/4	1 inch thick.
5/4	1¼ inches thick.
6/4	1½ inches thick.
8/4	2 inches thick.

LUMBER OFFICES OF DEPARTMENT OF COMMERCE

The National Committee on Wood Utilization, organized in 1925 by direction of President Coolidge, is composed of manufacturers, distributors, and consumers of lumber and wood products. Its chairman is R. P. Lamont, Secretary of Commerce; its vice chairman is R. Y. Stuart, Forester of the United States Department of Agriculture; its headquarters are in the Department of Commerce, Washington, D. C. The committee is a body made up of all branches of industry and trade interested in closer wood utilization, better manufacturing, distributing, and wood-using practices. The committee works in close cooperation with official and private agencies.

The Lumber Division of the Bureau of Foreign and Domestic Commerce is organized to give assistance to the trade in lumber and wood products. Through the oversea representatives of the Departments of Commerce and State, it is in close touch with markets throughout the world. The division gives American interests a detailed and comprehensive service of current foreign market information and sales assistance and guidance. The development of special services for the domestic lumber trade was started late in 1929.

The Department of Commerce has 79 district and cooperative offices throughout the United States, the latter being in chambers of commerce to assist American business men to supply foreign needs. It has 56 offices abroad, in all important trade centers, to assist buyers in getting their requirements from the United States.

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